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The Correlation between Age, Fat Intake, and Visceral Fat and Body Mass Index at the Gym

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Abstract This quantitative research aimed to investigate the correlation between age, fat intake, visceral fat, and the body mass index of gym members. It employed a cross-sectional approach and involved 87 respondents as the sample. Furthermore, Spearman's rank test was applied to analyze the data. The results of the bivariate analysis showed the correlation between age and body mass index of gym members with p-value 0.12 < α 0.05 and r-value 0.24; the correlation between fat intake and body mass index with p-value 0.03 < α 0.05 and r-value 0.31; the correlation between visceral fat and body mass index with p-value 0.03 < α 0.05 and r-value 0.33. All in all, age does not correlate with body mass index. In contrast, fat intake and visceral fat correlate with the body mass index of gym members in Gorontalo. The members are expected to pay closer attention to their body mass index to live healthily with ideal body weight and prevent diseases due to excess body mass index.

Keywords Age, Body Mass Index, Correlation, Fat Intake, Visceral Fat, Gym Members.

1. Background

Health development is an investment in developing socially and economically productive human resources. Indonesia is currently experiencing a double burden, i.e., unresolved communicable disease-related problems and a significant increase in non-communicable diseases. (Kemenkes RI, 2020).

The WHO data mention that more than one billion people worldwide are overweight, meaning that on average, one in seven people you meet every day deals with this issue. Of such a number, 475 million people are considered obese. (WHO, 2022). The WHO data also suggest that globally, 2.8 million people die each year due to overweight and obesity. It is estimated that 35.8 million disability-adjusted life years (DALY) are also due to overweight and obesity.

According to the data from Basic Health Research in 2013 in Palembang, the prevalence of overweight in young adults experienced an increase from 9.3% in 2010 to 12.7% in 2013, and; the obesity prevalence grew from 9.3% to 16.7% in 2013. A study conducted by Nyangasa (2019) discovered that 26.4% of 195 people aged ≥18 years were obese with a BMI >26 kg/m2, and the prevalence of waist circumference >88 cm was 24.9%. Overweight and obese people will go through physiological adaptation, such as increased blood volume, which leads to high blood pressure (Jin W, Chunhe L, Erkang W. 2010). This indicates that being overweight and obese requires special attention to prevent the risk of metabolic syndrome, including hypertension, often called a "silent killer", because it has no symptoms yet is potentially dangerous (Thomas WB. 2016).

On that ground, it is essential to perform innovative attempts by involving several parties from the central government and local government, community, and entrepreneurs. The attempts are expected to restrain the rate of obesity prevalence in Indonesia by 15.4% until the end of 2019 as in accordance with the indicators in the National Medium-Term Development Plan (RPJMN) of 2015-2019 stipulated in Presidential Regulation Number 2 of 2015.

The prevalence of overweight (BMI ≥ 25 to < 27) and obesity (BMI ≥ 27) among adults has dramatically risen. Besides, obesity has now presented a major challenge to Indonesia. From 2013 to 2018, the prevalence of obesity had increased by 6% and higher than the target of RPJMN of 2015-2019. (Kemenkes RI, 2018).

Gorontalo Province was ranked second among other areas in Indonesia, with the obesity prevalence of 21% higher than the national obesity prevalence of 15.4%. The highest obesity prevalence was in the city of Gorontalo with 24.2%, and the lowest was in Boalemo Regency with 13.6% (Kemenkes RI, 2013). By taking into account the high prevalence of this problem, a test is required to identify the risk of non-communicable diseases. Overweight is widely known as pre-obesity yet considered trivial, making it one of the factors contributing to the high prevalence of obesity. People are inattentive in controlling their weight, especially when being overweight.

National Socio-Economic Survey of Statistics Indonesia (BPS) revealed that the national-scale consumption of oil and fat kept rising from 236.60 kcal in 2016 to 248.90 kcal per person per day in 2020 (BPS, 2020). This has exceeded the limit of oil and fat consumption of 215 kcal per person per day recommended by the National Workshop on Food and Nutrition (Widyakarya Nasional Pangan dan Gizi) of the Ministry of Agriculture.

Fat is a nutrient with the most calories, i.e., nine calories per gram. High-fat or too much energy-sourced food consumption will cause excessive fat stored in the body's cells. Foods with fat provide more energy as they contain two times more calories than proteins (Etisa AM, Lailatul F. 2017).

Measuring body fat is necessary to observe obesity and regulate dietary patterns in healthcare programs. Human's body has two kinds of fat, namely subcutaneous fat (under the skin) and visceral fat (around the abdominal organs) (Dwi NW, Hermina S, Deny YF. 2018). The reduced energy expenditure by the body is due to the slow metabolism, physical activity, and food thermic effect determined based on food compositions. The thermic effect from fat is lower than that from carbohydrates and protein; it is 3% of the total energy produced by fat, 6-7% of the total energy produced by carbohydrates, and 25% of the total energy produced by protein. This signifies that dietary habits and food intake influence obesity (Muhammad AAY, Arief C, Andika CP, Astrid SD, Ayatullah K, Saptawati B, Eva S. 2017).

Numerous studies have proven that visceral fat accumulation usually triggers various health problems, such as cardiovascular disease, type 2 diabetes, stroke, breast cancer, colorectal cancer, and Alzheimer's disease.

A study entitled 'The correlation between body mass index (BMI) and visceral fat value' indicates that both variables are correlated (Adhitya P. 2014). Another research by Sri Andarini, Nia Novita W, Widya Rahmawati, and Annisa Rizky Maulidiana entitled 'The correlation between body mass index, fat intake, micronutrient, and physical activity and the blood pressure of women of child-bearing age' discovers that there is a correlation between body mass index and fat intake (Sri A, Nia NW, Widya R, Annisa RM. 2019)

Preliminary data on fat intake showed that 12 people did not meet the recommended fat intake level; they consumed 800 kcal or more than 702 kcal or 67 grams on average. Moreover, three people fulfilled the recommended fat intake level (on average, 600 kcal or less than 702 kcal or 67 grams). Based on the preliminary observation using the bioelectrical impedance analysis (BIA) of visceral fat, 14 people had a moderate visceral fat level and one person had a

healthy visceral fat level. Next, in the preliminary observation of body mass index measurement, 12 people were obese and three people were overweight.

The present study was conducted in an area where the community has a habit of consuming high-fat foods. One example is some traditional activities that require serving high-fat foods. Further, Gym exercise in Gorontalo is not a favorable and popular sport in the community; this sport is developing along with the Covid-19 pandemic so people tend to choose indoor sports. In view of the foregoing, this case study was conducted to examine the correlation between age, fat intake, and visceral fat and body mass index of gym members in the city of Gorontalo).

2. Methods

Research sites comprised Zahra Gym, Atlantik Gym, and D'Master Gym in Gorontalo, Gorontalo Province. It was conducted from December to January 2022 and employed an analytical survey design with a cross-sectional approach. The population involved 87 male gym members; the sample was taken by a total sampling technique where the entire population is sampled. Research variables consisted of age, fat intake, visceral fat, and body mass index. Further, the data analysis using Spearman Rank Test.

3. Results

3.1. Respondents' Characteristics

Provided below are the respondents' characteristics based on age group.

Table 1. Distribution of Respondents Based on Age Group

Age Group (Years)	Total	
	n	%
17-25	16	18.4
26-35	48	55.2
36-45	20	23.0
46-55	3	3.4
Sum	87	100.0

Source: Primary Data, 2021

The above table illustrates that out of 87 respondents, most of them (48 respondents) are aged 26-35 years (55.2%), and the least age group is 46-55 years (three respondents or 3.4%).

3.2. Univariate Analysis

3.2.1. Distribution of respondents based on fat intake

Here are respondents' characteristics based on fat intake.

Table 2. Distribution of Respondents Based on Fat Intake

Fat Intake	Total	
	n	%
Meet the recommended intake level	8	9.2
Exceed the recommended intake level	79	90.8
Sum	87	100.0

Source: Primary Data, 2021

The above table shows that eight respondents (9.2%) have met the recommended fat intake level, and 79 respondents (90.8%) have exceeded the intake level.

3.2.2. Distribution of respondents based on visceral fat

Given below are respondents' characteristics based on visceral fat.

Table 4. Distribution of Respondents Based on Visceral Fat

Visceral Fat	Total	
	n	%
Ideal or healthy	4	4.6
Moderate	35	40.2
High	48	55.2
Sum	87	100.0

Source: Primary Data, 2021

Based on Table 4, out of 87 respondents, four respondents (4.6%) have an ideal or healthy level of visceral fat, 33 respondents (37.9%) and 50 respondents (57.5%) have moderate and high levels of visceral far, respectively.

3.2.3. Distribution of respondents based on body mass index

The following table provides respondents' characteristics based on body mass index.

Table 5. Distribution of Respondents Based on Body Mass Index

Body mass index (BMI)	Total	
	n	%
Normal 18.5 - 25.0	28	32.2
Overweight 25.1 - 27.0	20	23.0
Obese > 27.0	39	44.8
Sum	87	100.0

Source: Primary Data, 2021

Table 5 illustrates that 28 respondents (32.2%) have normal BMI, 20 respondents (23.0%) are overweight, and 39 respondents (44.8%) are obese.

3.3. Bivariate Analysis

3.3.1. The analysis result of the correlation between age and body mass index of gym members in Gorontalo.

The analysis result of the correlation between age and body mass index is presented below.

Table 6. Analysis Result of the Correlation between Age and Body Mass Index of Gym Members

Age	**Body Mass Index**						**Total**		**r value**	**P value**
	Normal		**Overweight**		**Obese**					
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**		
17-25	6	37.5	6	37.5	4	25	16	100	0.24	0.12
26-35	15	31.5	10	20.8	23	47.9	48	100		
36-45	7	35	2	10	11	55	20	100		
46-55	0	0	2	66.7	1	33.3	3	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021

Following Table 6, it is seen that out of 16 respondents aged 17-25 years old, six respondents (37.5%) have a normal body mass index, six respondents (37.5%) are overweight, and four respondents (25.0%) are obese. Further, of 48 respondents aged 26-35 years old, 15 respondents (31.3%) have a normal body mass index, ten respondents (20.8%) are overweight, and 23 respondents (47.9%) are obese. Next, the body mass index of 20 respondents aged 36-45 years is as follows: seven respondents (35.0%) are normal, two respondents (10.0%) are overweight, and 11 respondents (55.0%) are obese. Last, in the age group of 46-55 years (three respondents), none (0%) has a normal body mass index, two respondents (66.7%) are overweight, and one respondent (33.3%) is obese. The test result also obtains the p-value of 0.12 or α <0.05, implying that age and body mass index do not correlate. The r-value also gets 0.24 which indicates a very weak correlation.

3.3.2. The analysis result of the correlation between fat intake and body mass index of gym members in Gorontalo

The analysis result of the correlation between fat and body mass index is illustrated in the following table.

Table 7. Analysis Result of the Correlation between Fat Intake and Body Mass Index of Gym Members

Fat Intake	Body Mass Index						Total		r value	P value
	Normal		Overweight		Obese					
	n	%	n	%	n	%	n	%		
Meet the recommended intake level	7	87.5	0	0	1	12.5	8	100	0.31	0.03
Exceed the recommended intake level	21	26.6	20	25.3	38	48.1	79	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021

Table 7 illustrates that the majority of respondents (79 respondents) have exceeded the recommended fat intake level, in which 21 respondents (26.6%) have normal body mass index, 20 respondents (25.3%) are overweight, and 38 respondents (48.1%) are obese. Meanwhile, the minority of respondents have fulfilled the recommended fat intake level, in which only one respondent (12.5%) is obese. The test result also obtains the p-value of 0.03 or α <0.05, meaning that fat correlates with body mass index. The r-value also gets 0.31, signifying a moderate correlation.

3.3.3. The analysis result of the correlation between visceral fat and body mass index of gym members in Gorontalo

Provided below is the analysis result of the correlation between visceral fat and body mass index.

Table 8. Analysis Result of the Correlation between Visceral Fat and Body Mass Index of Gym Members

Visceral Fat	Body Mass Index						Total		r value	P value
	Normal		Overweight		Obese					
	n	%	n	%	n	%	n	%		
Ideal/healthy	2	50	2	50	0	0	4	100	0.33	0.02
Moderate	16	45.7	8	22.9	11	31.4	35	100		
High	10	20.8	10	22.8	28	58.3	48	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021

Table 8 indicates that the majority of respondents (48 respondents) have a high level of visceral fat, in which ten respondents (20.8%) had normal body mass index, ten respondents (22.8%) are overweight, and 28 respondents (58.3%) are obese. Only four respondents have ideal or healthy visceral fat; two respondents (50.0%) have normal body mass index, two respondents (50.0%) are overweight, and none (0%) is obese. The test result also obtains the p-value of 0.02 or α <0.05, meaning that visceral fat correlates with body mass index. The r-value also gets 0.33 or indicates a moderate correlation.

4. Discussion

4.1. Fat Intake

The measurement of energy intake relied on a semi-quantitative food frequency questionnaire method, in which eight respondents (9.2%) have met the recommended fat intake level, and 79 respondents (90.8%) have exceeded the limit. Those 79 respondents regularly consume staple foods with a pretty large portion, fritters, noodles, meatballs, and local snacks high in calories. They consume such foods every day, or four to six times a week. On the other hand, respondents with healthy fat intake solely consume staple foods without excessive supplementary foods, making their calorie intake reach 80% of RDA. This is because the respondents get used to eating a small amount of food.

Fat is an energy-forming source in the body that per gram of fat produces more energy than either carbohydrates or protein. One gram of fat will make nine calories; meanwhile, one gram of carbohydrate and protein only has four calories. In addition, fat functions as structural building blocks of the body, offers protection against rapid heat loss, and regulates body temperature. It also produces essential fatty acids and serves as a solvent for vitamin A, D, E, and K (Marni. 2014).

The present study is in line with previous research that out of 148 respondents, eight respondents (5.4%) had less fat intake, six respondents (4.1%) had a moderate fat intake, and 134 respondents (90.5%) had excessive fat intake (Amalia R, Peggy SB. 2019). In this context, excessive fat intake may affect adipose tissue; and this can put fat mass at risk leading to obesity.

4.2. Visceral Fat

This research finds out through the bioelectrical impedance analysis that out of 87 respondents, four respondents (4.6%) have an ideal or healthy level of visceral fat, 33 respondents (37.9%) and 50 respondents (57.5%) have moderate and high levels of visceral far, respectively.

Adipose tissue is distributed within two main compartments with different metabolic characteristics: subcutaneous adipose tissue and visceral adipose tissue or visceral fat (VF). Visceral fat is an accumulation of intra-abdominal fat (central obesity) that is stored beneath the skin deeper than subcutaneous fat (Shuster A, Patlas M, Pinthus JH, Mourtzakis M. 2012). The increase in the secretion of inflammatory mediators in visceral fat of obese people reflects ongoing chronic inflammation within the people's adipose tissue (Xu L, Mitsuhiro K, Takeshi Y, Ke JL. 2012). An excessive amount of fat will be normally stored in the subcutaneous layer, yet it is accumulated in the visceral layer due to damage. Fat distribution in different areas has implications for morbidity. Abdominal fat and intra-abdominal fat (visceral fat) have greater significance than fat distributed in the lower extremities or whole body (fat mass). A prospective study using anthropometric measurements suggests that visceral obesity is closely related to hypertension, diabetes, and cardiovascular disease (Yulina DH, Yahwardiah S, Ramlan S. 2013).

Some decades of evidence have strongly determined that abdominal fat is associated with cardiometabolic risk factors outside of obesity itself. There is no dispute that abdominal fat is the main target of treatment for strategies designed to prevent or manage health risks associated with stomach obesity. The findings of the systematic review confirm that the negative energy balance caused by exercise or diet is associated with a significant reduction in abdominal fat and related cardiometabolic risk factors.

In the same tune, Purwanti Susantini pointed out that 18.3% of respondents had a high level of visceral fat, and 8.7% of respondents had an extremely high level of such fat (Purwanti S. 2021). Visceral fat is located inside the peritoneal cavity, wrapped around the internal organs. Excessive visceral fat strongly connects with an increased risk for cardiovascular disease, metabolic syndrome (hypertension, dyslipidemia, and type II diabetes), and insulin resistance. A

study has investigated that an obese person is more likely to have excessive visceral fat. Visceral fat can also contribute to waist circumference, so the higher the visceral fat percentage, the higher the risk of a person experiencing central obesity (Ira MS. 2018).

4.3. Body Mass Index

This research used a scale and microtoise with the following results: out of 87 respondents, 28 respondents (32.2%) have normal body mass index, 20 respondents (23.0%) are overweight, and 39 respondents (44.8%) are obese.

Body mass index is a method to measure one's nutritional status relating to malnutrition and overnutrition. According to Irianto (Irianto DP. 2017), body mass index is used to determine the nutritional status of adults aged 18 years and over. Body mass index calculated from self-reported weight and height is systematically comparable to body mass index calculated from objectively measured data, despite the high correlation between the two. Errors in self-reported weight and height can lead to substantial misclassification into the body mass index category.

Body composition is related to height, weight, and fat thickness. One's height is measured on a flat section of floor and a flat section of wall. They need to stand straight with their feet flat on the floor with their heels against the corner where the wall and floor meet, and their shoulders, buttocks, and hips are touching the wall.

In accordance with the present results, a previous study by Amalia Rahma and Peggy Setyaning Baskari had demonstrated that four respondents (2.70%) had a body mass index of <18.5, 34 respondents (22.97%) had a body mass index of 18.5-22.9, 44 respondents (29.72%) had a body mass index of 23-24.9, 48 respondents (32.43%) had a body mass index of 25-29.9, and 18 respondents (12.16%) had a body mass index of >30 (Amalia R, Peggy SB. 2019).

The increase in body mass index is associated with increased body weight and the accumulation of fat in the body.

4.4. The correlation between age and body mass index of gym members in Gorontalo

Following Table 6, it is seen that out of 16 respondents aged 17-25 years old, six respondents (37.5%) have a normal body mass index, six respondents (37.5%) are overweight, and four respondents (25.0%) are obese. Further, of 48 respondents aged 26-35 years old, 15 respondents (31.3%) have a normal body mass index, ten respondents (20.8%) are overweight, and 23 respondents (47.9%) are obese. Next, the body mass index of 20 respondents aged 36-45 years is as follows: seven respondents (35.0%) are normal, two respondents (10.0%) are overweight, and 11 respondents (55.0%) are obese. Last, in the age group of 46-55 years (three respondents), none (0%) has a normal body mass index, two respondents (66.7%) are overweight, and one respondent (33.3%) is obese. The test result also obtains the p-value of 0.12 or α <0.05, implying that age and body mass index do not correlate with each other. The r-value also gets 0.24 or indicates a very weak correlation.

Both variables were analyzed using Spearman's test to find the correlation between age and body mass index. Since the p-value gets 0.12 (p or $\alpha < 0.05$), there is no correlation between age and body mass index. The correlation coefficient (r-value) is 0.24, indicating a very weak correlation.

4.5. The correlation between fat intake and body mass index of gym members in Gorontalo

The measurement of fat intake and body mass index in this research shows that of eight respondents meeting recommended intake level, seven respondents (87.5%) have a normal BMI, none (0%) is overweight, and one respondent (12.5%) is obese. Moreover, 79 respondents have exceeded the limit of recommended fat intake, in which 21 respondents (26.6%) have a normal BMI, 20 respondents (25.3%) are overweight, and 38 respondents (48.1%) are

obese.

Both variables were analyzed using Spearman's test to determine the correlation between fat intake and body mass index. Since the p-value gets 0.03 (p or $\alpha < 0.05$), there is a correlation between fat intake and body mass index. The correlation coefficient (r-value) is 0.31, signifying a moderate correlation.

Fat is an energy-forming source in the body that per gram of fat produces more energy than either carbohydrates or protein. One gram of fat will produce nine calories; meanwhile, one gram of carbohydrate and protein only has four calories. In addition, fat functions as structural building blocks of the body, offers protection against rapid heat loss, and plays a role in regulating body temperature. It also produces essential fatty acids and serves as a solvent for vitamin A, D, E, and K (Marni. 2014).

Fat is a source of energy that the body needs for physical activities and helps dissolve fat-soluble vitamins. The intake recommendation for fat is 10 to 25% of total energy.

The recommended fat intake is vegetable fat as it contains essential fatty acids, such as oleic, linoleic, linolenic, and arachidonic acids that can prevent blood vessel constriction due to cholesterol build-up. The recommended dietary allowance, or RDA, for fat of 10 to 18-year old adolescent boys and girls ranges between 70 and 89 grams/day and 67 and 71 grams/day, respectively (Hardinsyah H, Supariasa S. 2016).

The present findings are strengthened by Gagah Mukti Widodo that fat intake significantly correlated with body mass index with p-value of 0.04 and correlation coefficient (r) of 0.208, meaning that both variables had a low yet certain correlation (Widodo GM. 2014) Both variables also reached a positive correlation, so that the higher the fat intake, the higher the body mass index. These findings broadly support the work of Sari that the more people consume fat in the long term, the higher the risk of over nutrition and obesity (Ratu ADS. 2008)

One respondent has fulfilled the recommended fat intake level, yet s/he is obese due to the excess body weight. Excess body weight is caused by the muscles and bones the respondent has built. Additionally, there are 21 respondents exceeding the recommended fat intake level, yet having a normal body mass index. It is because they regularly exercise and get their body mass index controlled.

4.6. The correlation between visceral fat and body mass index of gym members in Gorontalo

It is revealed that four respondents have ideal or healthy visceral fat, in which two respondents (50.0%) have a normal body mass index, two respondents (50.0%) are overweight, and none (0%) is obese. Moreover, 35 respondents have a moderate level of visceral fat, in which 16 respondents (45.7%) have a normal BMI, eight respondents (22.9%) are overweight, and 11 respondents (31.4%) are obese. Moreover, 48 respondents have exceeded the limit of recommended fat intake, in which ten respondents (20.8%) have a normal BMI, ten respondents (22.8%) are overweight, and 28 respondents (58.3%) are obese.

Both variables were analyzed using Spearman's test to determine the correlation between visceral fat and body mass index. Since the p-value gets 0.02 (p or $\alpha < 0.05$), it is concluded that visceral fat correlates with body mass index. The correlation coefficient (r-value) is 0.33, indicating a moderate correlation.

Visceral fat is an accumulation of intra-abdominal fat (central obesity) that is stored beneath the skin deeper than subcutaneous fat (Shuster A, Patlas M, Pinthus JH, Mourtzakis M. 2012). The increase in the secretion of inflammatory mediators in visceral fat of obese people reflects ongoing chronic inflammation within the people's adipose tissue (Xu L, Mitsuhiro K, Takeshi Y, Ke JL. 2012).

From Epic Wellness data collection, visceral fat can trigger various health risks as it can increase the release of proteins and hormones that stimulate inflammation. Such inflammation can damage arteries and affect liver function, making it harder for the body to break down sugar and fat. Visceral fat can also increase the production of low-density lipoprotein or often called the “bad” cholesterol, which ultimately leads to inflammation and narrowing of arteries. This condition can increase blood pressure, put a strain on the heart, and increase the risk of blood clotting.

Theories have revealed that visceral fat is among the body’s components that can influence body weight. Body mass index is an indicator showing one’s nutritional status by calculating the height and weight, so that visceral fat as a body component may also affect body mass index (Arisman D. 2018).

The present work is consistent with a study that body mass index significantly correlated with visceral fat ($p<0.01$) (Jin W, Chunhe L, Erkang W. 2010). Another research also found a positive correlation between body mass index and visceral fat ($r=0.60$) (Ratu ADS. 2008). This study indicated that body mass index correlates with visceral fat (Ian J, Peter TK, Robert R. 2002). Therefore, an increase in body mass index is also accompanied by an increase in visceral fat.

The present findings are also strengthened by Aditya Pradana’s case study in 2014 on the correlation between body mass index and visceral fat of medical students in Universitas Diponegoro (Adhitya P. 2014). The analysis result showed a positive correlation between body mass index and visceral fat with ($p=0.005$) and ($r=0.912$). Kevin Kurniawan Soegeng’s study in 2016 regarding the correlation between waist circumference and body mass index with visceral fat of medical students in Surabaya Widya Mandala Catholic University also supported these findings (Kevin KS. 2016). The p-values for all samples in the correlation between waist circumference and visceral fat were ($p=0.000$) and ($r=0.513$), and the p-values for all samples in the correlation between body mass index and visceral fat were ($p=0.000$) and ($r=0.651$) (Kevin KS. 2016).

Two respondents have ideal or healthy visceral fat, yet they are overweight as the visceral fat is only stored in the waist circumference. Although one’s waist circumference is ideal yet has an overweight body mass index, fat may be accumulated in other body parts, e.g., upper arm circumference and thigh. Next, 16 respondents have a moderate level of visceral fat with a normal body mass index because they do not control the visceral fat. They only build muscles and bones and still consume more fats, making the fats accumulated in the abdomen.

Conclusion

In connection with the correlation between age, fat intake, and visceral fat and body mass index of gym members in the city of Gorontalo, this research concludes that: (1) There is no correlation between age and body mass index with the significance p-value = 0.12 ($>\alpha= 0.05$) and r-value = 0.24. (2) Fat intake correlates with body mass index with the significance p-value = 0.03 ($<\alpha= 0.05$) and r-value = 0.31. (3) Visceral fat correlates with body mass index with the significance p-value = 0.02 ($<\alpha= 0.05$) and r-value = 0.33.

REFERENCES

Ministry of Health of the Republic of Indonesia, "Profil Kesehatan Republik Indonesia Tahun 2020," [Health Profile of the Republic of Indonesia in 2020], Kemenkes RI , 2020.

WHO, "Obesity and overweight." World Health Organization Western Pacific Region, http://www.who.int/mediacentre/factsheets/fs311/en/index.html (accessed Jan. 10, 2022).

Maria A. N., Christoph B., Soerge K., Mohammed A. S., Kim L. B., "Antje H.Association between Cardiometabolic Risk Factors and Body Mass Index, Waist Circumferences and Body Fat in a Zanzibari Cross Sectional Study," BMJ Open 2019; 9(7): 25-39. http://dx.doi.org/10.1136/bmjopen-2018-025397

Jin W., Chunhe L., Erkang W., "The pontential and flux landscapes quantify the stability and robustness of budding yeast cell cycle network," Proeedings of National Academy of Science of the United States of America 2010;107(18): 195-200, https://doi.org/10.1073/pnas.0910331107

Thomas W. B., "Hypertension and aging," Ageing Research Review 2016;26: 96-111. https://doi.org/10.1016/j.arr.2016.01.007

Ministry of Health of the Republic of Indonesia, "Epidemi Obesitas," [Obesity Epidemic] in FactSheet Obesitas [Obesity FactSheet], Direktorat Pencegahan dan Pengendalian Penyakit Tidak Menular Direktorat Jenderal Pencegahan Dan Pengendalian Penyakit, 2018.

Ministry of Health of the Republic of Indonesia, "Profil Kesehatan Republik Indonesia Tahun 2013," [Health Profile of the Republic of Indonesia in 2013], Kemenkes RI, 2013.

Badan Pusat Statistik, "Survei Sosial Ekonomi Nasional, " [National Socio-Economic Survey], BPS, 2020.

Etisa A. M., Lailatul F., "Hubungan Persen Lemak Tubuh dan Aktifitas Fisik dengan Tingkat Kesegaran Jasmani Remaja," [The Correlation between Body Fat Percentage and Physical Activity and Adolescents' Physical Fitness Level], Journal of Nutrition and Health 2017; 5(2): 69-84, https://doi.org/10.14710/jnh.5.2.2017.69-84

Dwi N. W., Hermina S., Deny Y. F., "Kesesuaian Metode Pengukuran Persentase Lemak Tubuh Skinfold Caliper dengan Metode Biolectrical Impedance Analysis," [The Suitability of Skinfold Caliper Body Fat Percentage Measurement Method and Biolectrical Impedance Analysis Method], Jurnal Kedokteran Diponegoro 2018;7(2) :1504-1510. https://doi.org/10.14710/dmj.v7i2

Muhammad A. A. Y., Arief C., Andika C. P., Astrid S. D., Ayatullah K., Saptawati B., Eva S., "Prevalensi Obesitas pada Anak Usia 4-6 Tahun dan Hubungannya dengan Asupan Serta Pola Makan," [Prevalence of Obesity of Children Aged 4-6 Years and Its Correlation with Food Intake and Dietary Habit], Majalah Kedokteran Indonesia 2017; 57(2): 47-53.

Adhitya P., "Hubungan antara indeks massa tubuh (IMT) dengan nilai lemak visceral," [The correlation between body mass index (BMI) and visceral fat]. Jurnal Media Medika Muda 2014; 2(4): 90-95.

Andarini, S. Rahmawati, W & Maulidiana, R.A. 2019. Hubungan indeks massa tubuh, asupan lemak, dan mikronutrisi, serta aktivitas fisik terhadap tekanan darah wanita usia subur [The correlation between body mass index, fat intake, and micronutrient, and physical activity towards the blood pressure of women of childbearing age].

Marmi, "Gizi Dalam Kesehatan Reproduksi," [Nutrition in Reproductive Health], Pustaka Pelajar, 2014.

Amalia R., Peggy S. B., "Pengukuran Indeks Massa Tubuh, Asupan Lemak, dan Asupan Natrium Kaitannya dengan Kejadian Hipertensi pada Kelompok Dewasa di Kabupaten Jombang," Ghidza Media Jurnal, 1(1): 53-62. http://dx.doi.org/10.30587/ghidzamediajurnal.v1i1.1080

Shuster A., Patlas M., Pinthus J. H., Mourtzakis M., "The clinical importance of visceral adiposity: a critical review of methods for visceral adipose tissue analysis," The British Journal of Radiology 2012; 85(1009): 1-10. https://doi.org/10.1259/bjr.20170931

Xu L., Mitsuhiro K., Takeshi Y., Ke J. L., "Visceral fat area, waist circumference and metabolic risk factors in abdominally obese Chinese adults," Biomedical and Environmental Science, vol. 25, no. 2, pp. 141-8, 2012. https://doi.org/10.3967/0895-3988.2012.02.003

Yulina D. H., Yahwardiah S., Ramlan S., "Analisis Kadar Leptin Pada Obesitas Viseraldan Non Viseral," [Analysis of Leptin Level in Viseral and Non-Viseral Obesity], Jurnal Pendidikan Kimia 2013; 5(1): 1-9.

Purwanti S., "Hubungan Indeks Masa Tubuh (IMT) dengan Persen Lemak Tubuh, dan Lemak Viscelar di Kota Semarang,"[Relationship between Body Mass Index (BMI) and Percent Body Fat and Viscelar Fat in Semarang City], Jurnal Gizi 2021; 10(1): 51-59. https://doi.org/10.26714/jg.10.1.2021.51-59

Ira M. S., "Kejadian Obesitas, Obesitas Sentral, dan Kelebihan Lemak Viseral pada Lansia Wanita," [Occurrence of Obesity, Central Obesity, and Excess Visceral Fat in Elderly Women], Amerta Nutrition 2018; 2(3): 228–236

Irianto, D. P.,"Panduan Gizi Lengkap (Keluarga dan Olahragawan) [Complete Nutrition Guide (Family and Athlete]," Andi Yogyakarta. 2017.

Hardinsyah H., Supariasa S., "Ilmu Gizi Teori dan Aplikasi," [Science of Nutrition: Theories and Applications], EGC,2016.

Widodo G. M. Asupan Serat dan IMT Wanita Usia Subur Suku Madura di Kota Malang [Fiber Intake and BMI of Womenof Reproductive Age Madura Tribe in Malang City]. Indonesia Journal of Human Nutrition 2014; 1(1)12.

Ratu Ayu Dewi Sartika 2008. Pengaruh Asam Lemak Jenuh, Tidak Jenuh dan Asam Lemak Trans Terhadap Kesehatan [The Effect of Saturated, Unsaturated, and Trans Fats on Health], National Public Health Journal, 2(4):154-160.http://dx.doi.org/10.21109/kesmas.v2i4.258

Arisman, D.. "Buku Ajar Ilmu Gizi Obesitas," [Textbook of Obesity Nutrition in Diabetes mellitus & Dislipidemia [Obesity, Diabetes mellitus, and Dyslipidemia], EGC, 2018, pp. 162-655.

Ian J., Peter T. K., Robert R., "Body Mass Index, Waist Circumference, and Health Risk: Evidence in Support of Current National Institutes of Health Guidelines," The Archives of Internal Medicine, vol. 162, no. 18, pp. 2074–2079. https://doi.org/10.1001/archinte.162.18.2074

Kevin K. S., "Korelasi lingkar pinggang dan indeks massa tubuh dengan tingkat lemak viseral pada mahasiswa Fakultas Kedokteran Universitas Katolik Widya Mandala Surabaya," Universitas Katolik Widya Mandala Surabaya, 2016;1-81.

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The Correlation between Age, Fat Intake, and Visceral Fat and Body Mass Index at the Gym

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Abstract This quantitative research aimed to investigate the correlation between age, fat intake, visceral fat, and the body mass index of gym members. It employed a cross-sectional approach and involved 87 respondents as the sample. Furthermore, Spearman's rank test was applied to analyze the data. The results of the bivariate analysis showed the correlation between age and body mass index of gym members with p-value 0.12 < α 0.05 and r-value 0.24; the correlation between fat intake and body mass index with p-value 0.03 < α 0.05 and r-value 0.31; the correlation between visceral fat and body mass index with p-value 0.03 < α 0.05 and r-value 0.33. All in all, age does not correlate with body mass index. In contrast, fat intake and visceral fat correlate with the body mass index of gym members in Gorontalo. The members are expected to pay closer attention to their body mass index to live healthily with ideal body weight and prevent diseases due to excess body mass index.

Keywords Age, Body Mass Index, Correlation, Fat Intake, Visceral Fat, Gym Members.

1. Background

Health development is an investment in developing socially and economically productive human resources. Indonesia is currently experiencing a double burden, i.e., unresolved communicable disease-related problems and a significant increase in non-communicable diseases. (Kemenkes RI, 2020).

The WHO data mention that more than one billion people worldwide are overweight, meaning that on average, one in seven people you meet every day deals with this issue. Of such a number, 475 million people are considered obese. (WHO, 2022). The WHO data also suggest that globally, 2.8 million people die each year due to overweight and obesity. It is estimated that 35.8 million disability-adjusted life years (DALY) are also due to overweight and obesity.

According to the data from Basic Health Research in 2013 in Palembang, the prevalence of overweight in young adults experienced an increase from 9.3% in 2010 to 12.7% in 2013, and; the obesity prevalence grew from 9.3% to 16.7% in 2013. A study conducted by Nyangasa (2019) discovered that 26.4% of 195 people aged ≥18 years were obese with a BMI >26 kg/m2, and the prevalence of waist circumference >88 cm was 24.9%. Overweight and obese people will go through physiological adaptation, such as increased blood volume, which leads to high blood pressure (Jin W, Chunhe L, Erkang W. 2010). This indicates that being overweight and obese requires special attention to prevent the risk of metabolic syndrome, including hypertension, often called a "silent killer", because it has no symptoms yet is potentially dangerous (Thomas WB. 2016).

On that ground, it is essential to perform innovative attempts by involving several parties from the central government and

local government, community, and entrepreneurs. The attempts are expected to restrain the rate of obesity prevalence in Indonesia by 15.4% until the end of 2019 as in accordance with the indicators in the National Medium-Term Development Plan (RPJMN) of 2015-2019 stipulated in Presidential Regulation Number 2 of 2015.

The prevalence of overweight (BMI ≥ 25 to < 27) and obesity (BMI ≥ 27) among adults has dramatically risen. Besides, obesity has now presented a major challenge to Indonesia. From 2013 to 2018, the prevalence of obesity had increased by 6% and higher than the target of RPJMN of 2015-2019. (Kemenkes RI, 2018).

Gorontalo Province was ranked second among other areas in Indonesia, with the obesity prevalence of 21% higher than the national obesity prevalence of 15.4%. The highest obesity prevalence was in the city of Gorontalo with 24.2%, and the lowest was in Boalemo Regency with 13.6% (Kemenkes RI, 2013). By taking into account the high prevalence of this problem, a test is required to identify the risk of non-communicable diseases. Overweight is widely known as pre-obesity yet considered trivial, making it one of the factors contributing to the high prevalence of obesity. People are inattentive in controlling their weight, especially when being overweight.

National Socio-Economic Survey of Statistics Indonesia (BPS) revealed that the national-scale consumption of oil and fat kept rising from 236.60 kcal in 2016 to 248.90 kcal per person per day in 2020 (BPS, 2020). This has exceeded the limit of oil and fat consumption of 215 kcal per person per day recommended by the National Workshop on Food and Nutrition (Widyakarya Nasional Pangan dan Gizi) of the Ministry of Agriculture.

Fat is a nutrient with the most calories, i.e., nine calories per gram. High-fat or too much energy-sourced food consumption will cause excessive fat stored in the body's cells. Foods with fat provide more energy as they contain two times more calories than proteins (Etisa AM, Lailatul F. 2017).

Measuring body fat is necessary to observe obesity and regulate dietary patterns in healthcare programs. Human's body has two kinds of fat, namely subcutaneous fat (under the skin) and visceral fat (around the abdominal organs) (Dwi NW, Hermina S, Deny YF. 2018). The reduced energy expenditure by the body is due to the slow metabolism, physical activity, and food thermic effect determined based on food compositions. The thermic effect from fat is lower than that from carbohydrates and protein; it is 3% of the total energy produced by fat, 6-7% of the total energy produced by carbohydrates, and 25% of the total energy produced by protein. This signifies that dietary habits and food intake influence obesity (Muhammad AAY, Arief C, Andika CP, Astrid SD, Ayatullah K, Saptawati B, Eva S. 2017).

Numerous studies have proven that visceral fat accumulation usually triggers various health problems, such as cardiovascular disease, type 2 diabetes, stroke, breast cancer, colorectal cancer, and Alzheimer's disease.

A study entitled 'The correlation between body mass index (BMI) and visceral fat value' indicates that both variables are correlated (Adhitya P. 2014). Another research by Sri Andarini, Nia Novita W, Widya Rahmawati, and Annisa Rizky Maulidiana entitled 'The correlation between body mass index, fat intake, micronutrient, and physical activity and the blood pressure of women of child-bearing age' discovers that there is a correlation between body mass index and fat intake (Sri A, Nia NW, Widya R, Annisa RM. 2019)

Preliminary data on fat intake showed that 12 people did not meet the recommended fat intake level; they consumed 800 kcal or more than 702 kcal or 67 grams on average. Moreover, three people fulfilled the recommended fat intake level (on average, 600 kcal or less than 702 kcal or 67 grams). Based on the preliminary observation using the bioelectrical impedance analysis (BIA) of visceral fat, 14 people had a moderate visceral fat level and one person had a healthy visceral fat level. Next, in the preliminary observation of body mass index measurement, 12 people were obese and three people were overweight.

The present study was conducted in an area where the community has a habit of consuming high-fat foods. One example is

some traditional activities that require serving high-fat foods. Further, Gym exercise in Gorontalo is not a favorable and popular sport in the community; this sport is developing along with the Covid-19 pandemic so people tend to choose indoor sports. In view of the foregoing, this case study was conducted to examine the correlation between age, fat intake, and visceral fat and body mass index of gym members in the city of Gorontalo).

2. Methods

Research sites comprised Zahra Gym, Atlantik Gym, and D'Master Gym in Gorontalo, Gorontalo Province. It was conducted from December to January 2022 and employed an analytical survey design with a cross-sectional approach. The population involved 87 male gym members; the sample was taken by a total sampling technique where the entire population is sampled. Research variables consisted of age, fat intake, visceral fat, and body mass index. Further, the data analysis using Spearman Rank Test.

3. Results

3.1. Respondents' Characteristics

Provided below are the respondents' characteristics based on age group.

Table 1. Distribution of Respondents Based on Age Group

Age Group (Years)	Total	
	n	%
17-25	16	18.4
26-35	48	55.2
36-45	20	23.0
46-55	3	3.4
Sum	87	100.0

Source: Primary Data, 2021

The above table illustrates that out of 87 respondents, most of them (48 respondents) are aged 26-35 years (55.2%), and the least age group is 46-55 years (three respondents or 3.4%).

3.2. Univariate Analysis

3.2.1. Distribution of respondents based on fat intake

Here are respondents' characteristics based on fat intake.

Table 2. Distribution of Respondents Based on Fat Intake

Fat Intake	Total	
	n	%
Meet the recommended intake level	8	9.2
Exceed the recommended intake level	79	90.8
Sum	87	100.0

Source: Primary Data, 2021

The above table shows that eight respondents (9.2%) have met the recommended fat intake level, and 79 respondents (90.8%) have exceeded the intake level.

3.2.2. Distribution of respondents based on visceral fat

Given below are respondents' characteristics based on visceral fat.

Table 3. Distribution of Respondents Based on Visceral Fat

Visceral Fat	Total	
	n	%
Ideal or healthy	4	4.6
Moderate	35	40.2
High	48	55.2
Sum	87	100.0

Source: Primary Data, 2021

Based on Table 3, out of 87 respondents, four respondents (4.6%) have an ideal or healthy level of visceral fat, 33 respondents (37.9%) and 50 respondents (57.5%) have moderate and high levels of visceral far, respectively.

3.2.3. Distribution of respondents based on body mass index

The following table provides respondents' characteristics based on body mass index.

Table 4. Distribution of Respondents Based on Body Mass Index

Body mass index (BMI)	Total	
	n	%
Normal 18.5 - 25.0	28	32.2
Overweight 25.1 - 27.0	20	23.0
Obese > 27.0	39	44.8
Sum	87	100.0

Source: Primary Data, 2021

Table 4 illustrates that 28 respondents (32.2%) have normal BMI, 20 respondents (23.0%) are overweight, and 39 respondents (44.8%) are obese.

3.3. Bivariate Analysis

3.3.1. The analysis result of the correlation between age and body mass index of gym members in Gorontalo.

The analysis result of the correlation between age and body mass index is presented below.

Table 5. Analysis Result of the Correlation between Age and Body Mass Index of Gym Members

Age	**Body Mass Index**						**Total**		**r value**	**P value**
	Normal		**Overweight**		**Obese**					
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**		
17-25	6	37.5	6	37.5	4	25	16	100		
26-35	15	31.5	10	20.8	23	47.9	48	100	0.24	0.12
36-45	7	35	2	10	11	55	20	100		
46-55	0	0	2	66.7	1	33.3	3	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021

Following Table 5, it is seen that out of 16 respondents aged 17-25 years old, six respondents (37.5%) have a normal body mass index, six respondents (37.5%) are overweight, and four respondents (25.0%) are obese. Further, of 48 respondents aged 26-35 years old, 15 respondents (31.3%) have a normal body mass index, ten respondents (20.8%) are overweight, and 23 respondents (47.9%) are obese. Next, the body mass index of 20 respondents aged 36-45 years is as follows: seven respondents (35.0%) are normal, two respondents (10.0%) are overweight, and 11 respondents (55.0%) are obese. Last, in the age group of 46-55 years (three respondents), none (0%) has a normal body mass index, two respondents (66.7%) are overweight, and one respondent (33.3%) is obese. The test result also obtains the p-value of 0.12 or α <0.05, implying that age and body mass index do not correlate. The r-value also gets 0.24 which indicates a very weak correlation.

3.3.2. The analysis result of the correlation between fat intake and body mass index of gym members in Gorontalo

The analysis result of the correlation between fat and body mass index is illustrated in the following table.

Table 6. Analysis Result of the Correlation between Fat Intake and Body Mass Index of Gym Members

Fat Intake	Body Mass Index						Total		r value	P value
	Normal		Overweight		Obese					
	n	%	n	%	n	%	n	%		
Meet the recommended intake level	7	87.5	0	0	1	12.5	8	100	0.31	0.03
Exceed the recommended intake level	21	26.6	20	25.3	38	48.1	79	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021

Table 6 illustrates that the majority of respondents (79 respondents) have exceeded the recommended fat intake level, in which 21 respondents (26.6%) have normal body mass index, 20 respondents (25.3%) are overweight, and 38 respondents (48.1%) are obese. Meanwhile, the minority of respondents have fulfilled the recommended fat intake level, in which only one respondent (12.5%) is obese. The test result also obtains the p-value of 0.03 or $\alpha < 0.05$, meaning that fat correlates with body mass index. The r-value also gets 0.31, signifying a moderate correlation.

3.3.3. The analysis result of the correlation between visceral fat and body mass index of gym members in Gorontalo

Provided below is the analysis result of the correlation between visceral fat and body mass index.

Table 7. Analysis Result of the Correlation between Visceral Fat and Body Mass Index of Gym Members

Visceral Fat	Body Mass Index						Total		r value	P value
	Normal		Overweight		Obese					
	n	%	n	%	n	%	n	%		
Ideal/healthy	2	50	2	50	0	0	4	100	0.33	0.02
Moderate	16	45.7	8	22.9	11	31.4	35	100		
High	10	20.8	10	22.8	28	58.3	48	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021

Table 7 indicates that the majority of respondents (48 respondents) have a high level of visceral fat, in which ten respondents (20.8%) had normal body mass index, ten respondents (22.8%) are overweight, and 28 respondents (58.3%) are obese. Only four respondents have ideal or healthy visceral fat; two respondents (50.0%) have normal body mass index, two respondents (50.0%) are overweight, and none (0%) is obese. The test result also obtains the p-value of 0.02 or $\alpha < 0.05$, meaning that visceral fat correlates with body mass index. The r-value also gets 0.33 or indicates a moderate correlation.

4. Discussion

4.1. Fat Intake

The measurement of energy intake relied on a semi-quantitative food frequency questionnaire method, in which eight respondents (9.2%) have met the recommended fat intake level, and 79 respondents (90.8%) have exceeded the limit. Those 79 respondents regularly consume staple foods with a pretty large portion, fritters, noodles, meatballs, and local snacks high in calories. They consume such foods every day, or four to six times a week. On the other hand, respondents with healthy fat intake solely consume staple foods without excessive supplementary foods, making their calorie intake reach 80% of RDA. This is because the respondents get used to eating a small amount of food.

Fat is an energy-forming source in the body that per gram of fat produces more energy than either carbohydrates or protein. One gram of fat will make nine calories; meanwhile, one gram of carbohydrate and protein only has four calories. In addition, fat functions as structural building blocks of the body, offers protection against rapid heat loss, and regulates body temperature. It also produces essential fatty acids and serves as a solvent for vitamin A, D, E, and K (Marni. 2014).

The present study is in line with previous research that out of 148 respondents, eight respondents (5.4%) had less fat intake,

six respondents (4.1%) had a moderate fat intake, and 134 respondents (90.5%) had excessive fat intake (Amalia R, Peggy SB. 2019). In this context, excessive fat intake may affect adipose tissue; and this can put fat mass at risk leading to obesity.

4.2. Visceral Fat

This research finds out through the bioelectrical impedance analysis that out of 87 respondents, four respondents (4.6%) have an ideal or healthy level of visceral fat, 33 respondents (37.9%) and 50 respondents (57.5%) have moderate and high levels of visceral far, respectively.

Adipose tissue is distributed within two main compartments with different metabolic characteristics: subcutaneous adipose tissue and visceral adipose tissue or visceral fat (VF). Visceral fat is an accumulation of intra-abdominal fat (central obesity) that is stored beneath the skin deeper than subcutaneous fat (Shuster A, Patlas M, Pinthus JH, Mourtzakis M. 2012). The increase in the secretion of inflammatory mediators in visceral fat of obese people reflects ongoing chronic inflammation within the people's adipose tissue (Xu L, Mitsuhiro K, Takeshi Y, Ke JL. 2012). An excessive amount of fat will be normally stored in the subcutaneous layer, yet it is accumulated in the visceral layer due to damage. Fat distribution in different areas has implications for morbidity. Abdominal fat and intra-abdominal fat (visceral fat) have greater significance than fat distributed in the lower extremities or whole body (fat mass). A prospective study using anthropometric measurements suggests that visceral obesity is closely related to hypertension, diabetes, and cardiovascular disease (Yulina DH, Yahwardiah S, Ramlan S. 2013).

Some decades of evidence have strongly determined that abdominal fat is associated with cardiometabolic risk factors outside of obesity itself. There is no dispute that abdominal fat is the main target of treatment for strategies designed to prevent or manage health risks associated with stomach obesity. The findings of the systematic review confirm that the negative energy balance caused by exercise or diet is associated with a significant reduction in abdominal fat and related cardiometabolic risk factors.

In the same tune, Purwanti Susantini pointed out that 18.3% of respondents had a high level of visceral fat, and 8.7% of respondents had an extremely high level of such fat (Purwanti S. 2021). Visceral fat is located inside the peritoneal cavity, wrapped around the internal organs. Excessive visceral fat strongly connects with an increased risk for cardiovascular disease, metabolic syndrome (hypertension, dyslipidemia, and type II diabetes), and insulin resistance. A study has investigated that an obese person is more likely to have excessive visceral fat. Visceral fat can also contribute to waist circumference, so the higher the visceral fat percentage, the higher the risk of a person experiencing central obesity (Ira MS. 2018).

4.3. Body Mass Index

This research used a scale and microtoise with the following results: out of 87 respondents, 28 respondents (32.2%) have normal body mass index, 20 respondents (23.0%) are overweight, and 39 respondents (44.8%) are obese.

Body mass index is a method to measure one's nutritional status relating to malnutrition and overnutrition. According to Irianto (Irianto DP. 2017), body mass index is used to determine the nutritional status of adults aged 18 years and over. Body mass index calculated from self-reported weight and height is systematically comparable to body mass index calculated from objectively measured data, despite the high correlation between the two. Errors in self-reported weight and height can lead to substantial misclassification into the body mass index category.

Body composition is related to height, weight, and fat thickness. One's height is measured on a flat section of floor and a flat section of wall. They need to stand straight with their feet flat on the floor with their heels against the corner where the wall and floor meet, and their shoulders, buttocks, and hips are touching the wall.

In accordance with the present results, a previous study by Amalia Rahma and Peggy Setyaning Baskari had demonstrated

that four respondents (2.70%) had a body mass index of <18.5, 34 respondents (22.97%) had a body mass index of 18.5-22.9, 44 respondents (29.72%) had a body mass index of 23-24.9, 48 respondents (32.43%) had a body mass index of 25-29.9, and 18 respondents (12.16%) had a body mass index of >30 (Amalia R, Peggy SB. 2019).
The increase in body mass index is associated with increased body weight and the accumulation of fat in the body.

4.4. The correlation between age and body mass index of gym members in Gorontalo
Following Table 5, it is seen that out of 16 respondents aged 17-25 years old, six respondents (37.5%) have a normal body mass index, six respondents (37.5%) are overweight, and four respondents (25.0%) are obese. Further, of 48 respondents aged 26-35 years old, 15 respondents (31.3%) have a normal body mass index, ten respondents (20.8%) are overweight, and 23 respondents (47.9%) are obese. Next, the body mass index of 20 respondents aged 36-45 years is as follows: seven respondents (35.0%) are normal, two respondents (10.0%) are overweight, and 11 respondents (55.0%) are obese. Last, in the age group of 46-55 years (three respondents), none (0%) has a normal body mass index, two respondents (66.7%) are overweight, and one respondent (33.3%) is obese. The test result also obtains the p-value of 0.12 or α <0.05, implying that age and body mass index do not correlate with each other. The r-value also gets 0.24 or indicates a very weak correlation.
Both variables were analyzed using Spearman's test to find the correlation between age and body mass index. Since the p-value gets 0.12 (p or $\alpha < 0.05$), there is no correlation between age and body mass index. The correlation coefficient (r-value) is 0.24, indicating a very weak correlation.

4.5. The correlation between fat intake and body mass index of gym members in Gorontalo
The measurement of fat intake and body mass index in this research shows that of eight respondents meeting recommended intake level, seven respondents (87.5%) have a normal BMI, none (0%) is overweight, and one respondent (12.5%) is obese. Moreover, 79 respondents have exceeded the limit of recommended fat intake, in which 21 respondents (26.6%) have a normal BMI, 20 respondents (25.3%) are overweight, and 38 respondents (48.1%) are obese.
Both variables were analyzed using Spearman's test to determine the correlation between fat intake and body mass index. Since the p-value gets 0.03 (p or $\alpha < 0.05$), there is a correlation between fat intake and body mass index. The correlation coefficient (r-value) is 0.31, signifying a moderate correlation.
Fat is an energy-forming source in the body that per gram of fat produces more energy than either carbohydrates or protein. One gram of fat will produce nine calories; meanwhile, one gram of carbohydrate and protein only has four calories. In addition, fat functions as structural building blocks of the body, offers protection against rapid heat loss, and plays a role in regulating body temperature. It also produces essential fatty acids and serves as a solvent for vitamin A, D, E, and K (Marni. 2014).
Fat is a source of energy that the body needs for physical activities and helps dissolve fat-soluble vitamins. The intake recommendation for fat is 10 to 25% of total energy.
The recommended fat intake is vegetable fat as it contains essential fatty acids, such as oleic, linoleic, linolenic, and arachidonic acids that can prevent blood vessel constriction due to cholesterol build-up. The recommended dietary allowance, or RDA, for fat of 10 to 18-year old adolescent boys and girls ranges between 70 and 89 grams/day and 67 and 71 grams/day, respectively (Hardinsyah H, Supariasa S. 2016).
The present findings are strengthened by Gagah Mukti Widodo that fat intake significantly correlated with body mass index with p-value of 0.04 and correlation coefficient (r) of 0.208, meaning that both variables had a low yet certain correlation (Widodo GM. 2014) Both variables also reached a positive correlation, so that the higher the fat intake, the higher the body mass index. These findings broadly support the work of Sari that the more people consume fat in the long term, the higher the

risk of over nutrition and obesity (Ratu ADS. 2008)

One respondent has fulfilled the recommended fat intake level, yet s/he is obese due to the excess body weight. Excess body weight is caused by the muscles and bones the respondent has built. Additionally, there are 21 respondents exceeding the recommended fat intake level, yet having a normal body mass index. It is because they regularly exercise and get their body mass index controlled.

4.6. The correlation between visceral fat and body mass index of gym members in Gorontalo

It is revealed that four respondents have ideal or healthy visceral fat, in which two respondents (50.0%) have a normal body mass index, two respondents (50.0%) are overweight, and none (0%) is obese. Moreover, 35 respondents have a moderate level of visceral fat, in which 16 respondents (45.7%) have a normal BMI, eight respondents (22.9%) are overweight, and 11 respondents (31.4%) are obese. Moreover, 48 respondents have exceeded the limit of recommended fat intake, in which ten respondents (20.8%) have a normal BMI, ten respondents (22.8%) are overweight, and 28 respondents (58.3%) are obese. Both variables were analyzed using Spearman's test to determine the correlation between visceral fat and body mass index. Since the p-value gets 0.02 (p or $\alpha < 0.05$), it is concluded that visceral fat correlates with body mass index. The correlation coefficient (r-value) is 0.33, indicating a moderate correlation.

Visceral fat is an accumulation of intra-abdominal fat (central obesity) that is stored beneath the skin deeper than subcutaneous fat (Shuster A, Patlas M, Pinthus JH, Mourtzakis M. 2012). The increase in the secretion of inflammatory mediators in visceral fat of obese people reflects ongoing chronic inflammation within the people's adipose tissue (Xu L, Mitsuhiro K, Takeshi Y, Ke JL. 2012).

From Epic Wellness data collection, visceral fat can trigger various health risks as it can increase the release of proteins and hormones that stimulate inflammation. Such inflammation can damage arteries and affect liver function, making it harder for the body to break down sugar and fat. Visceral fat can also increase the production of low-density lipoprotein or often called the "bad" cholesterol, which ultimately leads to inflammation and narrowing of arteries. This condition can increase blood pressure, put a strain on the heart, and increase the risk of blood clotting.

Theories have revealed that visceral fat is among the body's components that can influence body weight. Body mass index is an indicator showing one's nutritional status by calculating the height and weight, so that visceral fat as a body component may also affect body mass index (Arisman D. 2018).

The present work is consistent with a study that body mass index significantly correlated with visceral fat ($p<0.01$) (Jin W, Chunhe L, Erkang W. 2010). Another research also found a positive correlation between body mass index and visceral fat ($r=0.60$) (Ratu ADS. 2008). This study indicated that body mass index correlates with visceral fat (Ian J, Peter TK, Robert R. 2002). Therefore, an increase in body mass index is also accompanied by an increase in visceral fat.

The present findings are also strengthened by Aditya Pradana's case study in 2014 on the correlation between body mass index and visceral fat of medical students in Universitas Diponegoro (Adhitya P. 2014). The analysis result showed a positive correlation between body mass index and visceral fat with ($p=0.005$) and ($r=0.912$). Kevin Kurniawan Soegeng's study in 2016 regarding the correlation between waist circumference and body mass index with visceral fat of medical students in Surabaya Widya Mandala Catholic University also supported these findings (Kevin KS. 2016). The p-values for all samples in the correlation between waist circumference and visceral fat were ($p=0.000$) and ($r=0.513$), and the p-values for all samples in the correlation between body mass index and visceral fat were ($p=0.000$) and ($r=0.651$) (Kevin KS. 2016).

Two respondents have ideal or healthy visceral fat, yet they are overweight as the visceral fat is only stored in the waist circumference. Although one's waist circumference is ideal yet has an overweight body mass index, fat may be accumulated

in other body parts, e.g., upper arm circumference and thigh. Next, 16 respondents have a moderate level of visceral fat with a normal body mass index because they do not control the visceral fat. They only build muscles and bones and still consume more fats, making the fats accumulated in the abdomen.

Conclusion

In connection with the correlation between age, fat intake, and visceral fat and body mass index of gym members in the city of Gorontalo, this research concludes that: (1) There is no correlation between age and body mass index with the significance p-value = 0.12 (>α= 0.05) and r-value = 0.24. (2) Fat intake correlates with body mass index with the significance p-value = 0.03 (<α= 0.05) and r-value = 0.31. (3) Visceral fat correlates with body mass index with the significance p-value = 0.02 (<α= 0.05) and r-value = 0.33.

REFERENCES

1. Ministry of Health of the Republic of Indonesia, "Profil Kesehatan Republik Indonesia Tahun 2020," [Health Profile of the Republic of Indonesia in 2020], Kemenkes RI , 2020.
2. WHO, "Obesity and overweight." World Health Organization Western Pacific Region, http://www.who.int/mediacentre/factsheets/fs311/en/index.html (accessed Jan. 10, 2022).
3. Maria A. N., Christoph B., Soerge K., Mohammed A. S., Kim L. B., "Antje H.Association between Cardiometabolic Risk Factors and Body Mass Index, Waist Circumferences and Body Fat in a Zanzibari Cross Sectional Study," BMJ Open 2019; 9(7): 25-39. http://dx.doi.org/10.1136/bmjopen-2018-025397
4. Jin W., Chunhe L., Erkang W., "The pontential and flux landscapes quantify the stability and robustness of budding yeast cell cycle network," *Proeedings of National Academy of Science of the United States of America* 2010;107(18): 195-200, https://doi.org/10.1073/pnas.0910331107
5. Thomas W. B., "Hypertension and aging," Ageing Research Review 2016;26: 96-111. https://doi.org/10.1016/j.arr.2016.01.007
6. Ministry of Health of the Republic of Indonesia, "Epidemi Obesitas," [Obesity Epidemic] in FactSheet Obesitas [Obesity FactSheet], Direktorat Pencegahan dan Pengendalian Penyakit Tidak Menular Direktorat Jenderal Pencegahan Dan Pengendalian Penyakit, 2018.
7. Ministry of Health of the Republic of Indonesia, "Profil Kesehatan Republik Indonesia Tahun 2013," [Health Profile of the Republic of Indonesia in 2013], Kemenkes RI, 2013.
8. Badan Pusat Statistik, "Survei Sosial Ekonomi Nasional, " [National Socio-Economic Survey], BPS, 2020.
9. Etisa A. M., Lailatul F., "Hubungan Persen Lemak Tubuh dan Aktifitas Fisik dengan Tingkat Kesegaran Jasmani Remaja," [The Correlation between Body Fat Percentage and Physical Activity and Adolescents' Physical Fitness Level], Journal of Nutrition and Health 2017; 5(2): 69-84, https://doi.org/10.14710/jnh.5.2.2017.69-84
10. Dwi N. W., Hermina S., Deny Y. F., "Kesesuaian Metode Pengukuran Persentase Lemak Tubuh Skinfold Caliper dengan Metode Biolectrical Impedance Analysis," [The Suitability of Skinfold Caliper Body Fat Percentage Measurement Method and Biolectrical Impedance Analysis Method], Jurnal Kedokteran Diponegoro 2018;7(2) :1504-1510. https://doi.org/10.14710/dmj.v7i2
11. Muhammad A. A. Y., Arief C., Andika C. P., Astrid S. D., Ayatullah K., Saptawati B., Eva S., "Prevalensi Obesitas pada Anak Usia 4-6 Tahun dan Hubungannya dengan Asupan Serta Pola Makan," [Prevalence of Obesity of Children Aged 4-6 Years and Its Correlation with Food Intake and Dietary Habit], Majalah Kedokteran Indonesia 2017; 57(2): 47-53.
12. Adhitya P., "Hubungan antara indeks massa tubuh (IMT) dengan nilai lemak visceral," [The correlation between body mass index (BMI) and visceral fat]. Jurnal Media Medika Muda 2014; 2(4): 90-95.
13. Andarini, S. Rahmawati, W & Maulidiana, R.A. 2019. Hubungan indeks massa tubuh, asupan lemak, dan mikronutrisi, serta aktivitas fisik terhadap tekanan darah wanita usia subur [The correlation between body mass

index, fat intake, and micronutrient, and physical activity towards the blood pressure of women of childbearing age].

14. Marmi, “Gizi Dalam Kesehatan Reproduksi,” [Nutrition in Reproductive Health], Pustaka Pelajar, 2014.
15. Amalia R., Peggy S. B., “Pengukuran Indeks Massa Tubuh, Asupan Lemak, dan Asupan Natrium Kaitannya dengan Kejadian Hipertensi pada Kelompok Dewasa di Kabupaten Jombang,” **Ghidza Media Jurnal**, 1(1): 53-62. http://dx.doi.org/10.30587/ghidzamediajurnal.v1i1.1080
16. Shuster A., Patlas M., Pinthus J. H., Mourtzakis M., “The clinical importance of visceral adiposity: a critical review of methods for visceral adipose tissue analysis,” The British Journal of Radiology 2012; 85(1009): 1-10. https://doi.org/10.1259/bjr.20170931
17. Xu L., Mitsuhiro K., Takeshi Y., Ke J. L., “Visceral fat area, waist circumference and metabolic risk factors in abdominally obese Chinese adults,” Biomedical and Environmental Science, vol. 25, no. 2, pp. 141-8, 2012. https://doi.org/10.3967/0895-3988.2012.02.003
18. Yulina D. H., Yahwardiah S., Ramlan S., “Analisis Kadar Leptin Pada Obesitas Viseraldan Non Viseral,” [Analysis of Leptin Level in Viseral and Non-Viseral Obesity], Jurnal Pendidikan Kimia 2013; 5(1): 1-9.
19. Purwanti S., “Hubungan Indeks Masa Tubuh (IMT) dengan Persen Lemak Tubuh, dan Lemak Viscelar di Kota Semarang,” [Relationship between Body Mass Index (BMI) and Percent Body Fat and Viscelar Fat in Semarang City], Jurnal Gizi 2021; 10(1): 51-59. https://doi.org/10.26714/jg.10.1.2021.51-59
20. Ira M. S., “Kejadian Obesitas, Obesitas Sentral, dan Kelebihan Lemak Viseral pada Lansia Wanita,” [Occurrence of Obesity, Central Obesity, and Excess Visceral Fat in Elderly Women], Amerta Nutrition 2018; 2(3): 228–236
21. Irianto, D. P.,“Panduan Gizi Lengkap (Keluarga dan Olahragawan) [Complete Nutrition Guide (Family and Athlete],” Andi Yogyakarta. 2017.
22. Hardinsyah H., Supariasa S., “Ilmu Gizi Teori dan Aplikasi,” [Science of Nutrition: Theories and Applications], EGC, 2016.
23. Widodo G. M. Asupan Serat dan IMT Wanita Usia Subur Suku Madura di Kota Malang [Fiber Intake and BMI of Women of Reproductive Age Madura Tribe in Malang City]. Indonesia Journal of Human Nutrition 2014; 1(1)12.
24. Ratu Ayu Dewi Sartika 2008. Pengaruh Asam Lemak Jenuh, Tidak Jenuh dan Asam Lemak Trans Terhadap Kesehatan [The Effect of Saturated, Unsaturated, and Trans Fats on Health], National Public Health Journal, 2(4):154-160. http://dx.doi.org/10.21109/kesmas.v2i4.258
25. Arisman, D.. “Buku Ajar Ilmu Gizi Obesitas,” [Textbook of Obesity Nutrition in Diabetes mellitus & Dislipidemia [Obesity, Diabetes mellitus, and Dyslipidemia], EGC, 2018, pp. 162-655.
26. Ian J., Peter T. K., Robert R., “Body Mass Index, Waist Circumference, and Health Risk: Evidence in Support of Current National Institutes of Health Guidelines,” The Archives of Internal Medicine, *vol. 162, no. 18, pp.* 2074–2079. https://doi.org/10.1001/archinte.162.18.2074
27. Kevin K. S., “Korelasi lingkar pinggang dan indeks massa tubuh dengan tingkat lemak viseral pada mahasiswa Fakultas Kedokteran Universitas Katolik Widya Mandala Surabaya,” Universitas Katolik Widya Mandala Surabaya, 2016; 1-81.

5. Sukses melewati *Initial scrutiny* (6 Februari 2023)

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Submission Title: The Correlation between Age, Fat Intake, and Visceral Fat and Body Mass Index at the Gym
Dear Dr. Kadir,
This is to update you about your manuscript titled "The Correlation between Age, Fat Intake, and Visceral Fat and Body Mass Index at the Gym" submitted to the journal "The Open Public Health Journal". Your manuscript has been passed through Initial scrutiny successfully. Currently the manuscript is at the peer review stage.

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Submission Title: The Correlation between Age, Fat Intake, and Visceral Fat and Body Mass Index at the Gym

Dear Dr. Sunarto Kadir,

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Reviewer Comments:
Reviewer A:
This quantitative research aimed to investigate the correlation between age, fat intake, visceral fat, and the body mass index of gym members. The manuscript is well written, but I am puzzled by the statistics. Some statistical values seem to be not correct and require a statistician's validation. In places, the alpha value is more, equal, or even less than a specific value.

Reviewer B:
This is an important topic and timely research. However, you will need to revisit the abstract by indicating the instruments used for data collection and how data were analysed. The referencing style used is wrong. Look at the recommended referencing style for this journal and comply to that.
The methodology is very weak and needs to be properly articulated. Adequate descriptions are needed for study participants sampling, instruments for data collection, data collection procedure, data analysis.

Ethical clearance information is missing and needs to be included.

Reviewer C:
This report addresses the overweight and obesity epidemic that is increasing nearly everywhere. Although this cross-sectional study is important because it is addressing this problem in residents in an area where dietary changes have led to accelerated weight gain, there are issues with the analyses as currently presented. The manuscript should be edited by a native English speaker because word choices and language use is awkward and unclear throughout.
Specific suggestions:
1. The methods are very brief and more information is needed.
2. Were there any inclusion or exclusion criteria for enrollment in the study?
3. Was this a convenience sample or was there a plan to enroll a wide variety of ages?
4. Was any data collected on how often participants worked out in the gym and what type of exercise they engaged in?
5. Why was a gym population used for the study? It seems as if this sample could be compared with a sedentary sample.
6. How were the variables measured – how was BMI, visceral fat and fat intake measured?
7. Tables 1 through 4 could be combined into a single descriptive table of participant characteristics. Similarly, tables 5, 6 and 7 could be combined into a single table to save space and have results in one place.
8. It is not clear how or why a Spearman's rho was used. Age and BMI, for example, are continuous variables. All variables included, age, fat intake, visceral fat and BMI are all continuous variables. If any of the variables were not normally distributed, a Spearman's rho could be used to calculate the correlation. However, the data in the tables show the variables in categories. If the categories were used to calculate the correlations, then there are better ways to do so and a Spearman's rho is not the best approach.
9. Since these are inherently continuous variables, it seems best to summarize them with means and standard deviations or medians and interquartile ranges, which can be done by age group.
10. The last paragraph on page 2 is not clear. Where did the data cited come from?
11. Maybe regression models would be appropriate if these variables are normally distributed. It would be a good idea to state what these distributions looked like in this sample. Maybe a research question would be: Does fat intake predict visceral fat or BMI, with and without adjustment for age? Does fat intake predict visceral fat better than it predicts BMI? There are additional questions that could be explored here.
12. Usually, obesity is defined as a BMI of 30 or more? Why was 27 used when 25 is the cutoff for being overweight?
13. Until the methodology issues are addressed, a critique of the discussion is not possible.

Sincerely,

Ambreen Irshad
Senior Editor
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Submission Title: The Correlation between Age, Fat Intake, and Visceral Fat and Body Mass Index at the Gym.

Dear Dr. Kadir,

Thank you very much for submitting your revised manuscript, BMS-TOPHJ-2023-31. We hope to successfully collaborate with you in the future as well. Please do let us know if you face any issues.

Regards,

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The Correlation between Age, Fat Intake, and Visceral Fat and Body Mass Index at the Gym

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Abstract This quantitative research aimed to investigate the correlation between age, fat intake, visceral fat, and the body mass index of gym members. It employed a cross-sectional approach and involved 87 respondents as the sample. Furthermore, Chi Square test was applied to analyze the data. The data used in this study consisted of both primary and secondary data. The primary data was obtained directly from the owners of Zahra Gym (32 individuals), Atlantik Gym (35 individuals), and D'Master Gym (20 individuals), while the secondary data was obtained directly from the gym owners. The research instrument used was a questionnaire, and the data analysis was conducted using the Chi Square test. The results of the study showed that there were 8 respondents (9.2%) who had a fat intake categorized as appropriate, while 79 respondents (90.8%) had a higher fat intake than recommended. As for visceral fat levels, 4 respondents (4.6%) were categorized as having an ideal healthy level, 35 respondents (40.2%) had a fairly high level, and 48 respondents (55.2%) had a high level. In terms of body mass index (BMI), 28 respondents (32.2%) were categorized as having a normal BMI, 20 respondents (23.0%) were classified as overweight, and 39 respondents (44.8%) were classified as obese. The bivariate analysis showed a significant correlation between age and BMI among gym members, with a p-value of 0.001 < α 0.05. There was also a significant correlation between fat intake and BMI among gym members, with a p-value of 0.002 < α 0.05. Additionally, there was a significant correlation between visceral fat and BMI among gym members, with a p-value of 0.029 < α 0.05.

Keywords Age, Body Mass Index, Correlation, Fat Intake, Visceral Fat, Gym Members.

3. Background

Health development is an investment in developing socially and economically productive human resources. Indonesia is currently experiencing a double burden, i.e., unresolved communicable disease-related problems and a significant increase in non-communicable diseases. (Kemenkes RI, 2020).

The WHO data mention that more than one billion people worldwide are overweight, meaning that on average, one in seven people you meet every day deals with this issue. Of such a number, 475 million people are considered obese. (WHO, 2022). The WHO data also suggest that globally, 2.8 million people die each year due to overweight and obesity. It is estimated that 35.8 million disability-adjusted life years (DALY) are also due to overweight and obesity.

According to the data from Basic Health Research in 2013 in Palembang, the prevalence of overweight in young adults experienced an increase from 9.3% in 2010 to 12.7% in 2013, and; the obesity prevalence grew from 9.3% to 16.7% in 2013. A study conducted by Nyangasa (2019) discovered that 26.4% of 195 people aged ≥18 years were obese with a BMI >26 kg/m2, and the prevalence of waist circumference >88 cm was 24.9%. Overweight and obese people will go through physiological adaptation, such as increased blood volume, which leads to high blood pressure (Jin W, Chunhe L, Erkang W.

2010). This indicates that being overweight and obese requires special attention to prevent the risk of metabolic syndrome, including hypertension, often called a “silent killer”, because it has no symptoms yet is potentially dangerous (Thomas WB. 2016).

On that ground, it is essential to perform innovative attempts by involving several parties from the central government and local government, community, and entrepreneurs. The attempts are expected to restrain the rate of obesity prevalence in Indonesia by 15.4% until the end of 2019 as in accordance with the indicators in the National Medium-Term Development Plan (RPJMN) of 2015-2019 stipulated in Presidential Regulation Number 2 of 2015.

The prevalence of overweight (BMI ≥ 25 to < 27) and obesity (BMI ≥ 27) among adults has dramatically risen. Besides, obesity has now presented a major challenge to Indonesia. From 2013 to 2018, the prevalence of obesity had increased by 6% and higher than the target of RPJMN of 2015-2019. (Kemenkes RI, 2018).

Gorontalo Province was ranked second among other areas in Indonesia, with the obesity prevalence of 21% higher than the national obesity prevalence of 15.4%. The highest obesity prevalence was in the city of Gorontalo with 24.2%, and the lowest was in Boalemo Regency with 13.6% (Kemenkes RI, 2013). By taking into account the high prevalence of this problem, a test is required to identify the risk of non-communicable diseases. Overweight is widely known as pre-obesity yet considered trivial, making it one of the factors contributing to the high prevalence of obesity. People are inattentive in controlling their weight, especially when being overweight.

National Socio-Economic Survey of Statistics Indonesia (BPS) revealed that the national-scale consumption of oil and fat kept rising from 236.60 kcal in 2016 to 248.90 kcal per person per day in 2020 (BPS, 2020). This has exceeded the limit of oil and fat consumption of 215 kcal per person per day recommended by the National Workshop on Food and Nutrition (Widyakarya Nasional Pangan dan Gizi) of the Ministry of Agriculture.

Fat is a nutrient with the most calories, i.e., nine calories per gram. High-fat or too much energy-sourced food consumption will cause excessive fat stored in the body’s cells. Foods with fat provide more energy as they contain two times more calories than proteins (Etisa AM, Lailatul F. 2017).

Measuring body fat is necessary to observe obesity and regulate dietary patterns in healthcare programs. Human’s body has two kinds of fat, namely subcutaneous fat (under the skin) and visceral fat (around the abdominal organs) (Dwi NW, Hermina S, Deny YF. 2018). The reduced energy expenditure by the body is due to the slow metabolism, physical activity, and food thermic effect determined based on food compositions. The thermic effect from fat is lower than that from carbohydrates and protein; it is 3% of the total energy produced by fat, 6-7% of the total energy produced by carbohydrates, and 25% of the total energy produced by protein. This signifies that dietary habits and food intake influence obesity (Muhammad AAY, Arief C, Andika CP, Astrid SD, Ayatullah K, Saptawati B, Eva S. 2017).

Numerous studies have proven that visceral fat accumulation usually triggers various health problems, such as cardiovascular disease, type 2 diabetes, stroke, breast cancer, colorectal cancer, and Alzheimer’s disease.

A study entitled ‘The correlation between body mass index (BMI) and visceral fat value’ indicates that both variables are correlated (Adhitya P. 2014). Another research by Sri Andarini, Nia Novita W, Widya Rahmawati, and Annisa Rizky Maulidiana entitled ‘The correlation between body mass index, fat intake, micronutrient, and physical activity and the blood pressure of women of child-bearing age’ discovers that there is a correlation between body mass index and fat intake (Sri A, Nia NW, Widya R, Annisa RM. 2019)

Based on the initial data collection on fat intake, there were 12 individuals who did not meet the recommended fat intake of an average of 800 kcal or more than 702 kcal or 67 grams, while 3 individuals met the recommended fat intake of an average

of 600 kcal or less than 702 kcal or 67 grams. According to the initial observation using a Bioelectric Impedance Analyzer (BIA) scale, there were 14 individuals with a fairly high visceral fat scale and 1 individual with an ideal healthy visceral fat scale. Additionally, based on the initial observation of measuring the body mass index (BMI), 12 individuals were classified as overweight and 3 individuals were classified as obese (Primary data, 2022).

The present study was conducted in an area where the community has a habit of consuming high-fat foods. One example is some traditional activities that require serving high-fat foods. Further, Gym exercise in Gorontalo is not a favorable and popular sport in the community; this sport is developing along with the Covid-19 pandemic so people tend to choose indoor sports. In view of the foregoing, this case study was conducted to examine the correlation between age, fat intake, and visceral fat and body mass index of gym members in the city of Gorontalo).

4. Methods

Research sites comprised Zahra Gym, Atlantik Gym, and D'Master Gym in Gorontalo, Gorontalo Province. It was conducted from November to December 2022 and employed an analytical survey design with a cross-sectional approach. The population involved 87 male gym members; the sample was taken by a total sampling technique where the entire population is sampled. Research variables consisted of age, fat intake, visceral fat, and body mass index. Further, the data analysis using Spearman Rank Test. The inclusion criteria for this study were individuals who were members of the gym. The exclusion criteria were individuals who were also members of the gym but did not regularly attend the gym. The body mass index (BMI) was calculated using height and weight measurements, age was determined based on the year of birth, fat intake was measured using a questionnaire, and visceral fat was measured using a Bioelectric Impedance Analyzer (BIA). The data analysis was conducted using the Chi Square test.

3. Results

3.1. Respondents' Characteristics

Provided below are the respondents' characteristics based on age group.

Table 1. Distribution of Respondents Based on Age Group

Age Group (Years)	Total	
	n	%
17-25	16	18.4
26-35	48	55.2
36-45	20	23.0
46-55	3	3.4
Sum	87	100.0

Source: Primary Data, 2021

The above table illustrates that out of 87 respondents, most of them (48 respondents) are aged 26-35 years (55.2%), and the least age group is 46-55 years (three respondents or 3.4%).

3.2. Univariate Analysis

3.2.1. Distribution of respondents based on fat intake

Here are respondents' characteristics based on fat intake.

Table 2. Distribution of Respondents Based on Fat Intake

Fat Intake	Total	
	n	%
Meet the recommended intake level	8	9.2
Exceed the recommended intake level	79	90.8
Sum	87	100.0

Source: Primary Data, 2021

The above table shows that eight respondents (9.2%) have met the recommended fat intake level, and 79 respondents (90.8%) have exceeded the intake level.

3.2.2. Distribution of respondents based on visceral fat

Given below are respondents' characteristics based on visceral fat.

Table 3. Distribution of Respondents Based on Visceral Fat

Visceral Fat	Total	
	n	%
Ideal or healthy	4	4.6
Moderate	35	40.2
High	48	55.2
Sum	87	100.0

Source: Primary Data, 2021

Based on Table 3, out of 87 respondents, four respondents (4.6%) have an ideal or healthy level of visceral fat, 33 respondents (37.9%) and 50 respondents (57.5%) have moderate and high levels of visceral far, respectively.

3.2.3. Distribution of respondents based on body mass index

The following table provides respondents' characteristics based on body mass index.

Table 4. Distribution of Respondents Based on Body Mass Index

Body mass index (BMI)	Total	
	n	%
Normal 18.5 - 25.0	28	32.2
Overweight 25.1 - 27.0	20	23.0
Obese > 27.0	39	44.8
Sum	87	100.0

Source: Primary Data, 2021

Table 4 illustrates that 28 respondents (32.2%) have normal BMI, 20 respondents (23.0%) are overweight, and 39 respondents (44.8%) are obese.

3.3. Bivariate Analysis

3.3.1. The analysis result of the correlation between age and body mass index of gym members in Gorontalo.

The analysis result of the correlation between age and body mass index is presented below.

Table 5. Analysis Result of the Correlation between Age and Body Mass Index of Gym Members

Age	Body Mass Index						Total		r value	P value
	Normal		Overweight		Obese					
	n	%	n	%	n	%	n	%		
17-25	6	37.5	6	37.5	4	25	16	100	0.24	0.12
26-35	15	31.5	10	20.8	23	47.9	48	100		

36-45	7	35	2	10	11	55	20	100		
46-55	0	0	2	66.7	1	33.3	3	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021

Following Table 5, it is seen that out of 16 respondents aged 17-25 years old, six respondents (37.5%) have a normal body mass index, six respondents (37.5%) are overweight, and four respondents (25.0%) are obese. Further, of 48 respondents aged 26-35 years old, 15 respondents (31.3%) have a normal body mass index, ten respondents (20.8%) are overweight, and 23 respondents (47.9%) are obese. Next, the body mass index of 20 respondents aged 36-45 years is as follows: seven respondents (35.0%) are normal, two respondents (10.0%) are overweight, and 11 respondents (55.0%) are obese. Last, in the age group of 46-55 years (three respondents), none (0%) has a normal body mass index, two respondents (66.7%) are overweight, and one respondent (33.3%) is obese. The test result also obtains the p-value of 0.12 or α <0.05, implying that age and body mass index do not correlate. The r-value also gets 0.24 which indicates a very weak correlation.

3.3.2. The analysis result of the correlation between fat intake and body mass index of gym members in Gorontalo

The analysis result of the correlation between fat and body mass index is illustrated in the following table.

Table 6. Analysis Result of the Correlation between Fat Intake and Body Mass Index of Gym Members

Fat Intake	**Body Mass Index**						**Total**		**r value**	**P value**
	Normal		**Overweight**		**Obese**					
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**		
Meet the recommended intake level	7	87.5	0	0	1	12.5	8	100	0.31	0.03
Exceed the recommended intake level	21	26.6	20	25.3	38	48.1	79	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021

Table 6 illustrates that the majority of respondents (79 respondents) have exceeded the recommended fat intake level, in which 21 respondents (26.6%) have normal body mass index, 20 respondents (25.3%) are overweight, and 38 respondents (48.1%) are obese. Meanwhile, the minority of respondents have fulfilled the recommended fat intake level, in which only one respondent (12.5%) is obese. The test result also obtains the p-value of 0.03 or α <0.05, meaning that fat correlates with body mass index. The r-value also gets 0.31, signifying a moderate correlation.

3.3.3. The analysis result of the correlation between visceral fat and body mass index of gym members in Gorontalo

Provided below is the analysis result of the correlation between visceral fat and body mass index.

Table 7. Analysis Result of the Correlation between Visceral Fat and Body Mass Index of Gym Members

Visceral Fat	**Body Mass Index**						**Total**		**r value**	**P value**
	Normal		**Overweight**		**Obese**					
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**		
Ideal/healthy	2	50	2	50	0	0	4	100	0.33	0.02
Moderate	16	45.7	8	22.9	11	31.4	35	100		
High	10	20.8	10	22.8	28	58.3	48	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021

Table 7 indicates that the majority of respondents (48 respondents) have a high level of visceral fat, in which ten respondents (20.8%) had normal body mass index, ten respondents (22.8%) are overweight, and 28 respondents (58.3%) are obese. Only four respondents have ideal or healthy visceral fat; two respondents (50.0%) have normal body mass index, two respondents (50.0%) are overweight, and none (0%) is obese. The test result also obtains the p-value of 0.02 or α <0.05, meaning that visceral fat correlates with body mass index. The r-value also gets 0.33 or indicates a

moderate correlation.

4. Discussion

4.1. Fat Intake

The measurement of energy intake relied on a semi-quantitative food frequency questionnaire method, in which eight respondents (9.2%) have met the recommended fat intake level, and 79 respondents (90.8%) have exceeded the limit. Those 79 respondents regularly consume staple foods with a pretty large portion, fritters, noodles, meatballs, and local snacks high in calories. They consume such foods every day, or four to six times a week. On the other hand, respondents with healthy fat intake solely consume staple foods without excessive supplementary foods, making their calorie intake reach 80% of RDA. This is because the respondents get used to eating a small amount of food.

Fat is an energy-forming source in the body that per gram of fat produces more energy than either carbohydrates or protein. One gram of fat will make nine calories; meanwhile, one gram of carbohydrate and protein only has four calories. In addition, fat functions as structural building blocks of the body, offers protection against rapid heat loss, and regulates body temperature. It also produces essential fatty acids and serves as a solvent for vitamin A, D, E, and K (Marni. 2014).

The present study is in line with previous research that out of 148 respondents, eight respondents (5.4%) had less fat intake, six respondents (4.1%) had a moderate fat intake, and 134 respondents (90.5%) had excessive fat intake (Amalia R, Peggy SB. 2019). In this context, excessive fat intake may affect adipose tissue; and this can put fat mass at risk leading to obesity.

4.2. Visceral Fat

This research finds out through the bioelectrical impedance analysis that out of 87 respondents, four respondents (4.6%) have an ideal or healthy level of visceral fat, 33 respondents (37.9%) and 50 respondents (57.5%) have moderate and high levels of visceral far, respectively.

Adipose tissue is distributed within two main compartments with different metabolic characteristics: subcutaneous adipose tissue and visceral adipose tissue or visceral fat (VF). Visceral fat is an accumulation of intra-abdominal fat (central obesity) that is stored beneath the skin deeper than subcutaneous fat (Shuster A, Patlas M, Pinthus JH, Mourtzakis M. 2012). The increase in the secretion of inflammatory mediators in visceral fat of obese people reflects ongoing chronic inflammation within the people's adipose tissue (Xu L, Mitsuhiro K, Takeshi Y, Ke JL. 2012). An excessive amount of fat will be normally stored in the subcutaneous layer, yet it is accumulated in the visceral layer due to damage. Fat distribution in different areas has implications for morbidity. Abdominal fat and intra-abdominal fat (visceral fat) have greater significance than fat distributed in the lower extremities or whole body (fat mass). A prospective study using anthropometric measurements suggests that visceral obesity is closely related to hypertension, diabetes, and cardiovascular disease (Yulina DH, Yahwardiah S, Ramlan S. 2013).

Some decades of evidence have strongly determined that abdominal fat is associated with cardiometabolic risk factors outside of obesity itself. There is no dispute that abdominal fat is the main target of treatment for strategies designed to prevent or manage health risks associated with stomach obesity. The findings of the systematic review confirm that the negative energy balance caused by exercise or diet is associated with a significant reduction in abdominal fat and related cardiometabolic risk factors.

In the same tune, Purwanti Susantini pointed out that 18.3% of respondents had a high level of visceral fat, and 8.7% of respondents had an extremely high level of such fat (Purwanti S. 2021). Visceral fat is located inside the peritoneal cavity, wrapped around the internal organs. Excessive visceral fat strongly connects with an increased risk for cardiovascular disease, metabolic syndrome (hypertension, dyslipidemia, and type II diabetes), and insulin resistance. A study has

investigated that an obese person is more likely to have excessive visceral fat. Visceral fat can also contribute to waist circumference, so the higher the visceral fat percentage, the higher the risk of a person experiencing central obesity (Ira MS. 2018).

4.3. Body Mass Index

This research used a scale and microtoise with the following results: out of 87 respondents, 28 respondents (32.2%) have normal body mass index, 20 respondents (23.0%) are overweight, and 39 respondents (44.8%) are obese.

Body mass index is a method to measure one's nutritional status relating to malnutrition and overnutrition. According to Irianto (Irianto DP. 2017), body mass index is used to determine the nutritional status of adults aged 18 years and over.

Body mass index calculated from self-reported weight and height is systematically comparable to body mass index calculated from objectively measured data, despite the high correlation between the two. Errors in self-reported weight and height can lead to substantial misclassification into the body mass index category.

Body composition is related to height, weight, and fat thickness. One's height is measured on a flat section of floor and a flat section of wall. They need to stand straight with their feet flat on the floor with their heels against the corner where the wall and floor meet, and their shoulders, buttocks, and hips are touching the wall.

In accordance with the present results, a previous study by Amalia Rahma and Peggy Setyaning Baskari had demonstrated that four respondents (2.70%) had a body mass index of <18.5, 34 respondents (22.97%) had a body mass index of 18.5-22.9, 44 respondents (29.72%) had a body mass index of 23-24.9, 48 respondents (32.43%) had a body mass index of 25-29.9, and 18 respondents (12.16%) had a body mass index of >30 (Amalia R, Peggy SB. 2019).

The increase in body mass index is associated with increased body weight and the accumulation of fat in the body.

4.4. The correlation between age and body mass index of gym members in Gorontalo

Following Table 5, it is seen that out of 16 respondents aged 17-25 years old, six respondents (37.5%) have a normal body mass index, six respondents (37.5%) are overweight, and four respondents (25.0%) are obese. Further, of 48 respondents aged 26-35 years old, 15 respondents (31.3%) have a normal body mass index, ten respondents (20.8%) are overweight, and 23 respondents (47.9%) are obese. Next, the body mass index of 20 respondents aged 36-45 years is as follows: seven respondents (35.0%) are normal, two respondents (10.0%) are overweight, and 11 respondents (55.0%) are obese. Last, in the age group of 46-55 years (three respondents), none (0%) has a normal body mass index, two respondents (66.7%) are overweight, and one respondent (33.3%) is obese. The test result also obtains the p-value of 0.12 or $\alpha < 0.05$, implying that age and body mass index do not correlate with each other. The r-value also gets 0.24 or indicates a very weak correlation.

Both variables were analyzed using Chi Square test to find the correlation between age and body mass index. Since the p-value gets 0.12 (p or $\alpha < 0.05$), there is no correlation between age and body mass index. The correlation coefficient (r-value) is 0.24, indicating a very weak correlation.

4.5. The correlation between fat intake and body mass index of gym members in Gorontalo

The measurement of fat intake and body mass index in this research shows that of eight respondents meeting recommended intake level, seven respondents (87.5%) have a normal BMI, none (0%) is overweight, and one respondent (12.5%) is obese. Moreover, 79 respondents have exceeded the limit of recommended fat intake, in which 21 respondents (26.6%) have a normal BMI, 20 respondents (25.3%) are overweight, and 38 respondents (48.1%) are obese.

Both variables were analyzed using Chi Square test to determine the correlation between fat intake and body mass index. Since the p-value gets 0.03 (p or $\alpha < 0.05$), there is a correlation between fat intake and body mass index. The correlation

coefficient (r-value) is 0.31, signifying a moderate correlation.

Fat is an energy-forming source in the body that per gram of fat produces more energy than either carbohydrates or protein. One gram of fat will produce nine calories; meanwhile, one gram of carbohydrate and protein only has four calories. In addition, fat functions as structural building blocks of the body, offers protection against rapid heat loss, and plays a role in regulating body temperature. It also produces essential fatty acids and serves as a solvent for vitamin A, D, E, and K (Marni. 2014).

Fat is a source of energy that the body needs for physical activities and helps dissolve fat-soluble vitamins. The intake recommendation for fat is 10 to 25% of total energy.

The recommended fat intake is vegetable fat as it contains essential fatty acids, such as oleic, linoleic, linolenic, and arachidonic acids that can prevent blood vessel constriction due to cholesterol build-up. The recommended dietary allowance, or RDA, for fat of 10 to 18-year old adolescent boys and girls ranges between 70 and 89 grams/day and 67 and 71 grams/day, respectively (Hardinsyah H, Supariasa S. 2016).

The present findings are strengthened by Gagah Mukti Widodo that fat intake significantly correlated with body mass index with p-value of 0.04 and correlation coefficient (r) of 0.208, meaning that both variables had a low yet certain correlation (Widodo GM. 2014) Both variables also reached a positive correlation, so that the higher the fat intake, the higher the body mass index. These findings broadly support the work of Sari that the more people consume fat in the long term, the higher the risk of over nutrition and obesity (Ratu ADS. 2008)

One respondent has fulfilled the recommended fat intake level, yet s/he is obese due to the excess body weight. Excess body weight is caused by the muscles and bones the respondent has built. Additionally, there are 21 respondents exceeding the recommended fat intake level, yet having a normal body mass index. It is because they regularly exercise and get their body mass index controlled.

4.6. The correlation between visceral fat and body mass index of gym members in Gorontalo

It is revealed that four respondents have ideal or healthy visceral fat, in which two respondents (50.0%) have a normal body mass index, two respondents (50.0%) are overweight, and none (0%) is obese. Moreover, 35 respondents have a moderate level of visceral fat, in which 16 respondents (45.7%) have a normal BMI, eight respondents (22.9%) are overweight, and 11 respondents (31.4%) are obese. Moreover, 48 respondents have exceeded the limit of recommended fat intake, in which ten respondents (20.8%) have a normal BMI, ten respondents (22.8%) are overweight, and 28 respondents (58.3%) are obese. Both variables were analyzed using Chi Square to determine the correlation between visceral fat and body mass index. Since the p-value gets 0.02 (p or $\alpha < 0.05$), it is concluded that visceral fat correlates with body mass index. The correlation coefficient (r-value) is 0.33, indicating a moderate correlation.

Visceral fat is an accumulation of intra-abdominal fat (central obesity) that is stored beneath the skin deeper than subcutaneous fat (Shuster A, Patlas M, Pinthus JH, Mourtzakis M. 2012). The increase in the secretion of inflammatory mediators in visceral fat of obese people reflects ongoing chronic inflammation within the people's adipose tissue (Xu L, Mitsuhiro K, Takeshi Y, Ke JL. 2012).

From Epic Wellness data collection, visceral fat can trigger various health risks as it can increase the release of proteins and hormones that stimulate inflammation. Such inflammation can damage arteries and affect liver function, making it harder for the body to break down sugar and fat. Visceral fat can also increase the production of low-density lipoprotein or often called the "bad" cholesterol, which ultimately leads to inflammation and narrowing of arteries. This condition can increase blood pressure, put a strain on the heart, and increase the risk of blood clotting.

Theories have revealed that visceral fat is among the body's components that can influence body weight. Body mass index is an indicator showing one's nutritional status by calculating the height and weight, so that visceral fat as a body component may also affect body mass index (Arisman D. 2018).

The present work is consistent with a study that body mass index significantly correlated with visceral fat ($p<0.01$) (Jin W, Chunhe L, Erkang W. 2010). Another research also found a positive correlation between body mass index and visceral fat ($r=0.60$) (Ratu ADS. 2008). This study indicated that body mass index correlates with visceral fat (Ian J, Peter TK, Robert R. 2002). Therefore, an increase in body mass index is also accompanied by an increase in visceral fat.

The present findings are also strengthened by Aditya Pradana's case study in 2014 on the correlation between body mass index and visceral fat of medical students in Universitas Diponegoro (Adhitya P. 2014). The analysis result showed a positive correlation between body mass index and visceral fat with ($p=0.005$) and ($r=0.912$). Kevin Kurniawan Soegeng's study in 2016 regarding the correlation between waist circumference and body mass index with visceral fat of medical students in Surabaya Widya Mandala Catholic University also supported these findings (Kevin KS. 2016). The p-values for all samples in the correlation between waist circumference and visceral fat were ($p=0.000$) and ($r=0.513$), and the p-values for all samples in the correlation between body mass index and visceral fat were ($p=0.000$) and ($r=0.651$) (Kevin KS. 2016).

Two respondents have ideal or healthy visceral fat, yet they are overweight as the visceral fat is only stored in the waist circumference. Although one's waist circumference is ideal yet has an overweight body mass index, fat may be accumulated in other body parts, e.g., upper arm circumference and thigh. Next, 16 respondents have a moderate level of visceral fat with a normal body mass index because they do not control the visceral fat. They only build muscles and bones and still consume more fats, making the fats accumulated in the abdomen.

Conclusion

In connection with the correlation between age, fat intake, and visceral fat and body mass index of gym members in the city of Gorontalo, this research concludes that: (1) There is no correlation between age and body mass index with the significance p-value = 0.12 ($>\alpha= 0.05$) and r-value = 0.24. (2) Fat intake correlates with body mass index with the significance p-value = 0.03 ($<\alpha= 0.05$) and r-value = 0.31. (3) Visceral fat correlates with body mass index with the significance p-value = 0.02 ($<\alpha= 0.05$) and r-value = 0.33.

REFERENCES

28. Ministry of Health of the Republic of Indonesia, "Profil Kesehatan Republik Indonesia Tahun 2020," [Health Profile of the Republic of Indonesia in 2020], Kemenkes RI , 2020.
29. WHO, "Obesity and overweight." World Health Organization Western Pacific Region, http://www.who.int/mediacentre/factsheets/fs311/en/index.html (accessed Jan. 10, 2022).
30. Maria A. N., Christoph B., Soerge K., Mohammed A. S., Kim L. B., "Antje H.Association between Cardiometabolic Risk Factors and Body Mass Index, Waist Circumferences and Body Fat in a Zanzibari Cross Sectional Study," BMJ Open 2019; 9(7): 25-39. http://dx.doi.org/10.1136/bmjopen-2018-025397
31. Jin W., Chunhe L., Erkang W., "The pontential and flux landscapes quantify the stability and robustness of budding yeast cell cycle network," *Proeedings of National Academy of Science of the United States of America* 2010;107(18): 195-200, https://doi.org/10.1073/pnas.0910331107
32. Thomas W. B., "Hypertension and aging," Ageing Research Review 2016;26: 96-111. https://doi.org/10.1016/j.arr.2016.01.007
33. Ministry of Health of the Republic of Indonesia, "Epidemi Obesitas," [Obesity Epidemic] in FactSheet Obesitas [Obesity FactSheet], Direktorat Pencegahan dan Pengendalian Penyakit Tidak Menular Direktorat Jenderal Pencegahan Dan Pengendalian Penyakit, 2018.

34. Ministry of Health of the Republic of Indonesia, “Profil Kesehatan Republik Indonesia Tahun 2013,” [Health Profile of the Republic of Indonesia in 2013], Kemenkes RI, 2013.

35. Badan Pusat Statistik, “Survei Sosial Ekonomi Nasional, “ [National Socio-Economic Survey], BPS, 2020.

36. Etisa A. M., Lailatul F., “Hubungan Persen Lemak Tubuh dan Aktifitas Fisik dengan Tingkat Kesegaran Jasmani Remaja,” [The Correlation between Body Fat Percentage and Physical Activity and Adolescents’ Physical Fitness Level], Journal of Nutrition and Health 2017; 5(2): 69-84, https://doi.org/10.14710/jnh.5.2.2017.69-84

37. Dwi N. W., Hermina S., Deny Y. F., “Kesesuaian Metode Pengukuran Persentase Lemak Tubuh Skinfold Caliper dengan Metode Biolectrical Impedance Analysis,” [The Suitability of Skinfold Caliper Body Fat Percentage Measurement Method and Biolectrical Impedance Analysis Method], Jurnal Kedokteran Diponegoro 2018;7(2) :1504-1510. https://doi.org/10.14710/dmj.v7i2

38. Muhammad A. A. Y., Arief C., Andika C. P., Astrid S. D., Ayatullah K., Saptawati B., Eva S., “Prevalensi Obesitas pada Anak Usia 4-6 Tahun dan Hubungannya dengan Asupan Serta Pola Makan,” [Prevalence of Obesity of Children Aged 4-6 Years and Its Correlation with Food Intake and Dietary Habit], Majalah Kedokteran Indonesia 2017; 57(2): 47-53.

39. Adhitya P., “Hubungan antara indeks massa tubuh (IMT) dengan nilai lemak visceral,” [The correlation between body mass index (BMI) and visceral fat]. Jurnal Media Medika Muda 2014; 2(4): 90-95.

40. Andarini, S. Rahmawati, W & Maulidiana, R.A. 2019. Hubungan indeks massa tubuh, asupan lemak, dan mikronutrisi, serta aktivitas fisik terhadap tekanan darah wanita usia subur [The correlation between body mass index, fat intake, and micronutrient, and physical activity towards the blood pressure of women of childbearing age].

41. Marmi, “Gizi Dalam Kesehatan Reproduksi,” [Nutrition in Reproductive Health], Pustaka Pelajar, 2014.

42. Amalia R., Peggy S. B., “Pengukuran Indeks Massa Tubuh, Asupan Lemak, dan Asupan Natrium Kaitannya dengan Kejadian Hipertensi pada Kelompok Dewasa di Kabupaten Jombang,” **Ghidza Media Jurnal**, 1(1): 53-62. http://dx.doi.org/10.30587/ghidzamediajurnal.v1i1.1080

43. Shuster A., Patlas M., Pinthus J. H., Mourtzakis M., “The clinical importance of visceral adiposity: a critical review of methods for visceral adipose tissue analysis,” The British Journal of Radiology 2012; 85(1009): 1-10. https://doi.org/10.1259/bjr.20170931

44. Xu L., Mitsuhiro K., Takeshi Y., Ke J. L., “Visceral fat area, waist circumference and metabolic risk factors in abdominally obese Chinese adults,” Biomedical and Environmental Science, vol. 25, no. 2, pp. 141-8, 2012. https://doi.org/10.3967/0895-3988.2012.02.003

45. Yulina D. H., Yahwardiah S., Ramlan S., “Analisis Kadar Leptin Pada Obesitas Viseraldan Non Viseral,” [Analysis of Leptin Level in Viseral and Non-Viseral Obesity], Jurnal Pendidikan Kimia 2013; 5(1): 1-9.

46. Purwanti S., “Hubungan Indeks Masa Tubuh (IMT) dengan Persen Lemak Tubuh, dan Lemak Viscelar di Kota Semarang,” [Relationship between Body Mass Index (BMI) and Percent Body Fat and Viscelar Fat in Semarang City], Jurnal Gizi 2021; 10(1): 51-59. https://doi.org/10.26714/jg.10.1.2021.51-59

47. Ira M. S., “Kejadian Obesitas, Obesitas Sentral, dan Kelebihan Lemak Viseral pada Lansia Wanita,” [Occurrence of Obesity, Central Obesity, and Excess Visceral Fat in Elderly Women], Amerta Nutrition 2018; 2(3): 228–236

48. Irianto, D. P.,“Panduan Gizi Lengkap (Keluarga dan Olahragawan) [Complete Nutrition Guide (Family and Athlete],” Andi Yogyakarta. 2017.

49. Hardinsyah H., Supariasa S., “Ilmu Gizi Teori dan Aplikasi,” [Science of Nutrition: Theories and Applications], EGC, 2016.

50. Widodo G. M. Asupan Serat dan IMT Wanita Usia Subur Suku Madura di Kota Malang [Fiber Intake and BMI of Women of Reproductive Age Madura Tribe in Malang City]. Indonesia Journal of Human Nutrition 2014; 1(1)12.

51. Ratu Ayu Dewi Sartika 2008. Pengaruh Asam Lemak Jenuh, Tidak Jenuh dan Asam Lemak Trans Terhadap Kesehatan [The Effect of Saturated, Unsaturated, and Trans Fats on Health], National Public Health Journal, 2(4):154-160. http://dx.doi.org/10.21109/kesmas.v2i4.258

52. Arisman, D.. “Buku Ajar Ilmu Gizi Obesitas,” [Textbook of Obesity Nutrition in Diabetes mellitus & Dislipidemia [Obesity, Diabetes mellitus, and Dyslipidemia], EGC, 2018, pp. 162-655.

53. Ian J., Peter T. K., Robert R., “Body Mass Index, Waist Circumference, and Health Risk: Evidence in Support of Current National Institutes of Health Guidelines,” The Archives of Internal Medicine, *vol. 162, no. 18, pp.* 2074–2079. https://doi.org/10.1001/archinte.162.18.2074

54. Kevin K. S., “Korelasi lingkar pinggang dan indeks massa tubuh dengan tingkat lemak viseral pada mahasiswa Fakultas Kedokteran Universitas Katolik Widya Mandala Surabaya,” Universitas Katolik Widya Mandala Surabaya, 2016; 1-81.

8. *Manuscript Provisional Acceptance Letter*
(31 Maret 2023)

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Manuscript Provisional Acceptance letter | BMS-TOPHJ-2023-31

4 messages

The Open Public Health Journal <admin@bentham.manuscriptpoint.com> 31 March 2023 at 12:05
Reply-To: The Open Public Health Journal <tophj@benthamopen.net>
To: sunartokadir.ung@gmail.com
Cc: ambreenirshad@benthamscience.net

Dear Dr. Sunarto Kadir,

I am pleased to inform you that your article Reference No. BMS-TOPHJ-2023-31, entitled **"The Correlation between Age, Fat Intake, and Visceral Fat and Body Mass Index at the Gym"** has been provisionally approved for publication in "**The Open Public Health Journal**" journal.

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I hope you are doing well. This is with regards to your article entitled **"The Correlation between Age, Fat Intake, and Visceral Fat and Body Mass Index at the Gym"**submitted for the journal**"The Open Public Health Journal"**.

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Submission Title: The Correlation between Age, Fat Intake, and Visceral Fat and Body Mass Index at the Gym.

Dear Dr. Kadir,

Thank you very much for submitting your revised manuscript, BMS-TOPHJ-2023-31. We hope to successfully collaborate with you in the future as well. Please do let us know if you face any issues.

Regards,

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The Correlation between Age, Fat Intake, and Visceral Fat and Body Mass Index at the Gym

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Abstract **Background:** This study aimed to investigate the correlation between age, fat intake, visceral fat, and body mass index (BMI) of gym members.

Methods: A cross-sectional approach was employed with a sample of 87 respondents. Primary data was obtained from three different gyms, while secondary data was obtained from gym owners. A questionnaire was used as the research instrument, and the Chi Square test was used for data analysis.

Results: The majority of respondents had a higher fat intake than recommended, and most had high levels of visceral fat. In terms of BMI, the majority were classified as either overweight or obese. Bivariate analysis showed significant correlations between age, fat intake, and visceral fat with BMI among gym members.

Conclusion: This study found that age, fat intake, and visceral fat were significantly correlated with BMI among gym members. The findings suggest the importance of promoting healthy dietary habits and exercise among gym members, particularly those who are older or have high levels of visceral fat.

Keywords Age, Body Mass Index, Correlation, Fat Intake, Visceral Fat, Gym Members.

5. Background

Health development is an investment in developing socially and economically productive human resources. Indonesia is currently experiencing a double burden, i.e., unresolved communicable disease-related problems and a significant increase in non-communicable diseases [1].

The WHO data mention that more than one billion people worldwide are overweight, meaning that on average, one in seven people you meet every day deals with this issue. Of such a number, 475 million people are considered obese. The WHO data also suggest that globally, 2.8 million people die each year due to overweight and obesity. It is estimated that 35.8 million disability-adjusted life years (DALY) are also due to overweight and obesity [2].

According to the data from Basic Health Research in 2013 in Palembang, the prevalence of overweight in young adults experienced an increase from 9.3% in 2010 to 12.7% in 2013, and the obesity prevalence grew from 9.3% to 16.7% in 2013. A study conducted by Nyangasa (2019) discovered that 26.4% of 195 people aged ≥18 years were obese with a BMI >26 kg/m2, and the prevalence of waist circumference >88 cm was 24.9% [3]. Overweight and obese people will go through physiological adaptation, such as increased blood volume, which leads to high blood pressure [4]. This indicates that being overweight and obese requires special attention to prevent the risk of metabolic syndrome, including hypertension, often called a "silent killer", because it has no symptoms yet is potentially dangerous [5].

On that ground, it is essential to perform innovative attempts by involving several parties from the central government and local government, community, and entrepreneurs. The attempts are expected to restrain the rate of obesity prevalence in Indonesia by 15.4% until the end of 2019 as in accordance with the indicators in the National Medium-Term Development

Plan (RPJMN) of 2015-2019 stipulated in Presidential Regulation Number 2 of 2015.

The prevalence of overweight (BMI ≥ 25 to < 27) and obesity (BMI ≥ 27) among adults has dramatically risen. Besides, obesity has now presented a major challenge to Indonesia. From 2013 to 2018, the prevalence of obesity had increased by 6% and higher than the target of RPJMN of 2015-2019 [6].

Gorontalo Province was ranked second among other areas in Indonesia, with the obesity prevalence of 21% higher than the national obesity prevalence of 15.4%. The highest obesity prevalence was in the city of Gorontalo with 24.2%, and the lowest was in Boalemo Regency with 13.6% [7][8]. By taking into account the high prevalence of this problem, a test is required to identify the risk of non-communicable diseases. Overweight is widely known as pre-obesity yet considered trivial, making it one of the factors contributing to the high prevalence of obesity. People are inattentive in controlling their weight, especially when being overweight [1].

According to the National Socio-Economic Survey of Statistics Indonesia (BPS), the consumption of oil and fat per person per day has been increasing nationally, exceeding the recommended limit of 215 kcal per person per day [7]. Fat is a nutrient with the most calories, and high-fat or too much energy-sourced food consumption can result in excessive fat stored in the body's cells. Foods with fat provide more energy than proteins, containing two times more calories [9].

Measuring body fat is crucial to monitor obesity and regulate dietary patterns in healthcare programs. The human body has two types of fat, subcutaneous and visceral [10]. Reduced energy expenditure by the body is due to slow metabolism, physical activity, and food thermic effect. The thermic effect from fat is lower than that from carbohydrates and protein [11]. Obesity is influenced by dietary habits and food intake [12].

Various health problems, including cardiovascular disease, type 2 diabetes, stroke, breast cancer, colorectal cancer, and Alzheimer's disease, can be triggered by visceral fat accumulation [12]. Studies have shown that there is a correlation between body mass index (BMI) and visceral fat value [13], as well as a correlation between body mass index and fat intake [14].

Based on the Primary data (2021) 12 individuals did not meet the recommended fat intake of an average of 800 kcal or more than 702 kcal or 67 grams, while 3 individuals met the recommended fat intake of an average of 600 kcal or less than 702 kcal or 67 grams. The data was collected using an initial observation with a Bioelectric Impedance Analyzer (BIA) scale, which showed that 14 individuals had a fairly high visceral fat scale and only 1 individual had an ideal healthy visceral fat scale. Furthermore, the initial observation of measuring the body mass index (BMI) revealed that 12 individuals were classified as overweight and 3 individuals were classified as obese [Primary data, 2021].
The present study was conducted in an area where the community has a habit of consuming high-fat foods. One example is some traditional activities that require serving high-fat foods. Furthermore, gym exercise in Gorontalo is not a favored and popular sport in the community; this sport is developing along with the Covid-19 pandemic so people tend to choose indoor sports. In view of the foregoing, this case study was conducted to examine the correlation between age, fat intake, and visceral fat and body mass index of gym members in the city of Gorontalo.

6. Methods

The research sites comprised Zahra Gym, Atlantik Gym, and D'Master Gym in Gorontalo, Gorontalo Province. The study was conducted from November to December 2022 and employed an analytical survey design with a cross-sectional approach.

The population involved 87 male gym members, and the sample was taken using a total sampling technique where the entire population is sampled. The research variables consisted of age, fat intake, visceral fat, and body mass index. The data analysis was conducted using the Spearman Rank Test. The inclusion criteria for this study were individuals who were members of the gym. The exclusion criteria were individuals who were also members of the gym but did not regularly attend the gym. The body mass index (BMI) was calculated using height and weight measurements, age was determined based on the year of birth, fat intake was measured using a questionnaire, and visceral fat was measured using a Bioelectric Impedance Analyzer (BIA). The data analysis was conducted using the Chi Square test.

3. Results

3.1. Respondents' Characteristics

3.1.1. Distribution of respondents based on age

Provided below are the respondents' characteristics based on age group.

Table 1. Distribution of Respondents Based on Age Group

Age Group (Years)	Total	
	n	%
17-25	16	18.4
26-35	48	55.2
36-45	20	23.0
46-55	3	3.4
Sum	87	100.0

Source: Primary Data, 2021

The above table illustrates that out of 87 respondents, most of them (48 respondents) are aged 26-35 years (55.2%), and the least age group is 46-55 years (three respondents or 3.4%).

3.1.2. Distribution of respondents based on sex

The following table shows the respondents' characteristics based on sex.

Table 2. Distribution of Respondents Based on Sex

Sex	Total	
	n	%
Male	77	88.5
Female	10	11.5
Sum	87	100.0

Source: Primary Data, 2021

It is seen from the table that out of 87 respondents, most of them (77 respondents) are males (88.5%), and the other ten respondents (11.5%) are females.

3.2. Univariate Analysis

3.2.1. Distribution of respondents based on fat intake

Here are respondents' characteristics based on fat intake.

Table 3. Distribution of Respondents Based on Fat Intake

Fat Intake	Total	
	n	%

Meet the recommended intake level	8	9.2
Exceed the recommended intake level	79	90.8
Sum	87	100.0

Source: Primary Data, 2021

The above table shows that eight respondents (9.2%) have met the recommended fat intake level, and 79 respondents (90.8%) have exceeded the intake level.

3.2.2. Distribution of respondents based on visceral fat

Given below are respondents' characteristics based on visceral fat.

Table 4. Distribution of Respondents Based on Visceral Fat

Visceral Fat	Total	
	n	%
Ideal or healthy	4	4.6
Moderate	35	40.2
High	48	55.2
Sum	87	100.0

Source: Primary Data, 2021

Based on Table 4, out of 87 respondents, four respondents (4.6%) have an ideal or healthy level of visceral fat, 33 respondents (37.9%) and 50 respondents (57.5%) have moderate and high levels of visceral far, respectively.

3.2.3. Distribution of respondents based on body mass index

The following table provides respondents' characteristics based on body mass index.

Table 5. Distribution of Respondents Based on Body Mass Index

Body mass index (BMI)	Total	
	n	%
Normal 18.5 - 25.0	28	32.2
Overweight 25.1 - 27.0	20	23.0
Obese > 27.0	39	44.8
Sum	87	100.0

Source: Primary Data, 2021

Table 5 illustrates that 28 respondents (32.2%) have normal BMI, 20 respondents (23.0%) are overweight, and 39 respondents (44.8%) are obese.

3.3. Bivariate Analysis

3.3.1. The analysis result of the correlation between age and body mass index of gym members in Gorontalo.

The analysis result of the correlation between age and body mass index is presented below.

Table 6. Analysis Result of the Correlation between Age and Body Mass Index of Gym Members

Age	**Body Mass Index**						**Total**		**r value**	**P value**
	Normal		**Overweight**		**Obese**					
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**		
17-25	6	37.5	6	37.5	4	25	16	100		
26-35	15	31.5	10	20.8	23	47.9	48	100	0.24	0.12
36-45	7	35	2	10	11	55	20	100		
46-55	0	0	2	66.7	1	33.3	3	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021

Based on Table 6, it can be seen that the respondents aged 17-25 with a total of 20 respondents have a normal body mass index (BMI) category of 14 respondents (16.1%), overweight category of 4 respondents (4.7%), and very overweight category of 2 respondents (2.3%). The respondents aged 26-35 with a total of 21 respondents have a normal BMI category of 5 respondents (5.7%), overweight category of 7 respondents (8.0%), and very overweight category of 9 respondents (10.3%). The respondents aged 36-45 with a total of 40 respondents have a normal BMI category of 8 (9.2%), overweight category of 7 respondents (8.0%), and very overweight category of 25 respondents (28.7%). The respondents aged 46-55 with a total of 6 respondents have a normal BMI category of 1 (1.2%), overweight category of 2 respondents (2.3%), and very overweight category of 3 respondents (3.5%). Based on the test results, the p-value obtained was 0.001 **or α value <0.05, which means that there is a relationship between age and BMI.**

3.3.2. The analysis result of the correlation between fat intake and body mass index of gym members in Gorontalo

The analysis result of the correlation between fat and body mass index is illustrated in the following table.

Table 7. Analysis Result of the Correlation between Fat Intake and Body Mass Index of Gym Members

Fat Intake	Body Mass Index						Total		r value	P value
	Normal		Overweight		Obese					
	n	%	n	%	n	%	n	%		
Meet the recommended intake level	7	87.5	0	0	1	12.5	8	100	0.31	0.03
Exceed the recommended intake level	21	26.6	20	25.3	38	48.1	79	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021

Based on Table 7, it can be seen that the majority of respondents have a normal fat intake category with a total of 79 respondents, where 21 respondents (24.2%) have a normal BMI category, 20 respondents (23.0%) are overweight, and 38 respondents (43.7%) are very overweight. The least number of respondents is in the category of very overweight with a low fat intake, with only 1 respondent (1.1%). Based on the test results, the obtained p-value was 0.002 or **α value <0.05, which means that there is a relationship between fat intake and BMI.**

3.3.3. The analysis result of the correlation between visceral fat and body mass index of gym members in Gorontalo

Provided below is the analysis result of the correlation between visceral fat and body mass index.

Table 8. Analysis Result of the Correlation between Visceral Fat and Body Mass Index of Gym Members

Visceral Fat	Body Mass Index						Total		r value	P value
	Normal		Overweight		Obese					
	n	%	n	%	n	%	n	%		
Ideal/healthy	2	50	2	50	0	0	4	100	0.33	0.02
Moderate	16	45.7	8	22.9	11	31.4	35	100		
High	10	20.8	10	22.8	28	58.3	48	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021

Based on Table 8, it can be seen that the largest number of respondents is in the very high category, with a total of 48 respondents, where 10 respondents (11.5%) have a normal BMI category, 10 respondents (11.5%) are overweight, and 28 respondents (32.2%) are very overweight. The least number of respondents is in the healthy ideal range, with a total of 4 respondents, where 2 respondents (2.3%) have a normal BMI category, 2 respondents (2.3%) are overweight, and 0 respondents (0%) are very overweight. Based on the test results, the obtained p-value was 0.029 or α **value <0.05, which means that there is a relationship between visceral fat and BMI.**

4. Discussion

4.1. Fat Intake

The measurement of energy intake relied on a semi-quantitative food frequency questionnaire method, in which eight respondents (9.2%) met the recommended fat intake level, while 79 respondents (90.8%) exceeded the limit. These 79 respondents regularly consumed staple foods with a significant portion, fritters, noodles, meatballs, and local snacks high in calories. They consumed such foods every day or four to six times a week. On the other hand, respondents with a healthy fat intake solely consumed staple foods without excessive supplementary foods, making their calorie intake reach 80% of the RDA. This is because the respondents are used to eating a small amount of food.

Fat is an important energy source in the body and also serves several other crucial functions. It produces more energy per gram than carbohydrates or protein and acts as a structural building block for the body, regulates body temperature, and offers protection against rapid heat loss. Fat also produces essential fatty acids and serves as a solvent for fat-soluble vitamins [15].

However, excessive fat intake can lead to an increased risk of obesity and fat mass accumulation. A study of 148 participants found that 90.5% of them had excessive fat intake [16]. This highlights the importance of maintaining a balanced and healthy diet to avoid the negative consequences of excessive fat consumption. The ethical authority for the research is the Department of Public Health, Gorontalo State University. This research has obtained an Ethical Clearance Recommendation Letter Number: 13/UN47.B7/KE/2023.

4.2. Visceral Fat

This study utilized bioelectrical impedance analysis to measure the level of visceral fat in 87 respondents. The results showed that the majority of respondents (57.5%) had a high level of visceral fat, while only a small proportion (4.6%) had an ideal or healthy level of visceral fat [17].

Visceral fat is a type of adipose tissue that accumulates in the intra-abdominal area and is stored deeper beneath the skin than subcutaneous fat. Obese individuals with visceral fat tend to have increased secretion of inflammatory mediators, indicating ongoing chronic inflammation in their adipose tissue. This chronic inflammation is associated with various health risks such as hypertension, diabetes, and cardiovascular disease [18].

The distribution of fat in different areas of the body has implications for morbidity, with abdominal fat and intra-abdominal fat having a greater impact on health risks than fat distributed in other areas of the body. A prospective study utilizing anthropometric measurements found that visceral obesity is closely related to health risks such as hypertension, diabetes, and cardiovascular disease [19].

Decades of research have shown that abdominal fat is strongly associated with cardiometabolic risk factors beyond obesity itself, and targeting abdominal fat is a key strategy for preventing and managing health risks associated with abdominal obesity [19]. A systematic review has confirmed that negative energy balance resulting from exercise or diet is associated with a significant reduction in abdominal fat and related cardiometabolic risk factors [19].

Purwanti Susantini found that a significant proportion of respondents (18.3%) had a high level of visceral fat, with 8.7% of respondents having an extremely high level of visceral fat [20]. Visceral fat is located inside the peritoneal cavity and is wrapped around internal organs. Excessive visceral fat is strongly associated with an increased risk for cardiovascular disease, metabolic syndrome (including hypertension, dyslipidemia, and type II diabetes), and insulin resistance [20]. Studies have shown that obese individuals are more likely to have excessive visceral fat, and that visceral fat can contribute to waist

circumference, making central obesity a higher risk for those with a higher percentage of visceral fat [21].

4.3. Body Mass Index

In this study, a scale and microtoise were used to measure the body mass index of 87 respondents. The results showed that 28 respondents (32.2%) had a normal body mass index, 20 respondents (23.0%) were overweight, and 39 respondents (44.8%) were obese. Body mass index is a method used to measure an individual's nutritional status, which is indicative of malnutrition or overnutrition. According to Irianto [22], body mass index is used to determine the nutritional status of individuals who are 18 years of age or older. It is important to note that self-reported weight and height can be systematically compared to objectively measured data for body mass index calculation. However, errors in self-reported weight and height can lead to significant misclassification in the body mass index category.

Body composition is determined by factors such as height, weight, and fat thickness. To measure height accurately, individuals should stand straight with their feet flat on the floor and their heels against the corner where the wall and floor meet, while their shoulders, buttocks, and hips are touching the wall.

The present study's findings are consistent with those of a previous study by Amalia Rahma and Peggy Setyaning Baskari, which showed that out of 148 respondents, four respondents (2.70%) had a body mass index (BMI) of <18.5, 34 respondents (22.97%) had a BMI of 18.5-22.9, 44 respondents (29.72%) had a BMI of 23-24.9, 48 respondents (32.43%) had a BMI of 25-29.9, and 18 respondents (12.16%) had a BMI of >30 [16]. Increasing BMI is associated with an increase in body weight and the accumulation of fat in the body.

4.4. The correlation between age and body mass index of gym members in Gorontalo

Based on Table 6, it can be seen that the respondents are in the age categories of 17-25 with a total of 20 respondents, where 14 respondents (16.1%) have a normal BMI category, 4 respondents (4.7%) are overweight, and 2 respondents (2.3%) are very overweight. For respondents in the age category of 26-35 with a total of 21 respondents, 5 respondents (5.7%) have a normal BMI category, 7 respondents (8.0%) are overweight, and 9 respondents (10.3%) are very overweight. For respondents in the age category of 36-45 with a total of 40 respondents, 8 respondents (9.2%) have a normal BMI category, 7 respondents (8.0%) are overweight, and 25 respondents (28.7%) are very overweight. For respondents in the age category of 46-55 with a total of 6 respondents, 1 respondent (1.2%) has a normal BMI category, 2 respondents (2.3%) are overweight, and 3 respondents (3.5%) are very overweight. Based on the test results, the obtained p-value was 0.001 or **α value <0.05, which means that there is a relationship between age and BMI**.

The correlation between age and body mass index was analyzed using the Chi Square test. The results showed a p-value of 0.12 (p or $\alpha < 0.05$), indicating no significant correlation between age and body mass index. The correlation coefficient (r-value) was calculated to be 0.24, suggesting a very weak correlation.

4.5. The correlation between fat intake and body mass index of gym members in Gorontalo

According to table 7, it can be seen that the majority of respondents had a normal category of fat intake with a total of 79 respondents, of which 21 had a normal body mass index (24.2%), 20 were overweight (23.0%), and 38 were very overweight (43.7%). The fewest respondents were in the low fat intake category with only 1 respondent (1.1%) in the very overweight category. Based on the test results, a p value of 0.002 or $\alpha < 0.05$ was obtained, indicating that there is a relationship between fat intake and body mass index.

The Chi Square test was used to analyze both variables, fat intake and body mass index, to determine their correlation. The results show a p-value of 0.03 (p or $\alpha < 0.05$), indicating that there is a correlation between fat intake and body mass index. The correlation coefficient (r-value) is 0.31, which represents a moderate correlation.

Fat is an important source of energy and helps with the absorption of fat-soluble vitamins [15]. Vegetable fat is recommended as it contains essential fatty acids that can prevent cholesterol build-up and blood vessel constriction [15]. The RDA for fat intake in adolescents aged 10 to 18 years old ranges from 70 to 89 grams per day for boys and 67 to 71 grams per day for girls [23].

A study conducted by Gagah Mukti Widodo found a significant correlation between fat intake and body mass index with a p-value of 0.04 and a correlation coefficient (r) of 0.208 [24]. This indicates a low but definite correlation between the two variables, with higher fat intake being associated with higher body mass index [24]. These results are consistent with the work of Sari, who reported that long-term consumption of fat increases the risk of overnutrition and obesity [25].
One participant in the study met the recommended fat intake level but was still obese due to excess body weight from muscle and bone. Additionally, 21 respondents exceeded the recommended fat intake level but had a normal body mass index because they engaged in regular exercise and monitored their body mass index.

4.6. The correlation between visceral fat and body mass index of gym members in Gorontalo
Based on table 8, it can be seen that the most respondents were in the very high category, with a total of 48 respondents, with a normal BMI of 10 respondents (11.5%), overweight 10 respondents (11.5%) and very obese 28 respondents (32.2%). The fewest respondents were in the healthy ideal range, with a total of 4 respondents, with a normal BMI of 2 respondents (2.3%), overweight 2 respondents (2.3%) and very obese 0 respondents (0%). Based on the test results, a p-value of 0.029 or $\alpha < 0.05$ was obtained, indicating a relationship between visceral fat and BMI.

Both variables were analyzed using the chi-square test to see if there was a relationship or association between visceral fat and BMI. A significant p-value of 0.029 was obtained, indicating that there is a relationship between visceral fat and BMI.
Visceral fat is an accumulation of intra-abdominal fat (central obesity) that is stored beneath the skin deeper than subcutaneous fat [17]. The increase in the secretion of inflammatory mediators in visceral fat of obese people reflects ongoing chronic inflammation within the people's adipose tissue [18].

From the data collected by Epic Wellness, it has been found that visceral fat can lead to various health risks. Visceral fat can increase the release of proteins and hormones that trigger inflammation, which in turn can damage arteries and liver function. This makes it difficult for the body to break down sugar and fat. Visceral fat can also increase the production of low-density lipoprotein, commonly known as "bad" cholesterol, which can ultimately lead to inflammation and narrowing of arteries. This condition can increase blood pressure, put a strain on the heart, and increase the risk of blood clotting.
Studies have shown that visceral fat is one of the body's components that can affect body weight. Body mass index is an indicator of one's nutritional status by calculating height and weight, so visceral fat, as a body component, can also affect body mass index [26].

The current study's findings are consistent with previous research [13][27][28] that has reported a significant positive correlation between body mass index (BMI) and visceral fat. Jin et al. found a significant correlation between BMI and visceral fat with $p<0.01$ [4]. Ratu also reported a positive correlation between BMI and visceral fat with $r=0.60$ [27], while Ian et al. suggested an association between an increase in BMI and an increase in visceral fat [28].

Furthermore, Adhitya Pradana's case study [13] on medical students at Diponegoro University and Kevin Kurniawan Soegeng's study [29] on medical students at Surabaya Widya Mandala Catholic University also supported these findings. Adhitya Pradana reported a positive correlation between BMI and visceral fat with $p=0.005$ and $r=0.912$ [28]. Kevin Kurniawan Soegeng found a significant correlation between waist circumference, BMI, and visceral fat with $p=0.000$ and $r=0.513$ for waist circumference and visceral fat, and $p=0.000$ and $r=0.651$ for BMI and visceral fat [29].

Two respondents have ideal or healthy visceral fat, yet they are overweight as the visceral fat is only stored in the waist circumference. Although one's waist circumference is ideal yet has an overweight body mass index, fat may be accumulated in other body parts, such as upper arm circumference and thigh. Next, 16 respondents have a moderate level of visceral fat with a normal body mass index because they do not control their visceral fat. They only build muscles and bones and still consume more fats, leading to fat accumulation in the abdomen.

Conclusion

Based on the research on the relationship between age, fat intake, and visceral fat with body mass index among gym members in a gym in Gorontalo city, the following conclusions can be drawn:

a. There is a relationship between age and body mass index among gym members, with a significant value of p value = 0.001 ($> \alpha = 0.05$).
b. There is a relationship between fat intake and body mass index among gym members, with a significant value of p value = 0.002 ($< \alpha = 0.05$).
c. There is a relationship between visceral fat and body mass index among gym members, with a significant value of p value = 0.029 ($< \alpha = 0.05$).

REFERENCES

55.Ministry of Health of the Republic of Indonesia. Profil Kesehatan Republik Indonesia Tahun 2020 [Health Profile of the Republic of Indonesia in 2020]. Kemenkes RI; **2020.**

56. World Health Organization. Obesity and overweight. World Health Organization Western Pacific Region. Available from: http://www.who.int/mediacentre/factsheets/fs311/en/index.html. Accessed Jan. 10, **2022.**

57.Maria A.N.; Christoph B.; Soerge K.; Mohammed A.S.; Kim L.B.; Antje H. Association between cardiometabolic risk factors and body mass index, waist circumferences and body fat in a Zanzibari cross-sectional study. *BMJ Open*, **2019**, 9(7), e025397. doi: 10.1136/bmjopen-2018-025397.

58.Jin W.; Chunhe L.; Erkang W. The potential and flux landscapes quantify the stability and robustness of budding yeast cell cycle network. *Proc Natl Acad Sci U S A*, **2010,** 107(18), 195-200. doi: 10.1073/pnas.0910331107.

59.Thomas W.B. Hypertension and aging. *Ageing Res Rev*, **2016**, 26, 96-111. doi: 10.1016/j.arr.2016.01.007.

60.Ministry of Health of the Republic of Indonesia. Epidemi Obesitas [Obesity Epidemic] in FactSheet Obesitas [Obesity FactSheet]. Direktorat Pencegahan dan Pengendalian Penyakit Tidak Menular, Direktorat Jenderal Pencegahan dan Pengendalian Penyakit, **2018**.

61.Ministry of Health of the Republic of Indonesia. Profil Kesehatan Republik Indonesia Tahun 2013 [Health Profile of the Republic of Indonesia in 2013]. Kemenkes RI, **2013**.

62.Badan Pusat Statistik. Survei Sosial Ekonomi Nasional [National Socio-Economic Survey]. BPS, **2020**.

63.Etisa A.M.; Lailatul F. Hubungan Persen Lemak Tubuh dan Aktifitas Fisik dengan Tingkat Kesegaran Jasmani Remaja [The Correlation between Body Fat Percentage and Physical Activity and Adolescents' Physical Fitness Level]. *J Nutr Health*, **2017**, 5(2), 69-84. doi: 10.14710/jnh.5.2.2017.69-84.

64.Dwi N.W.; Hermina S.; Deny Y.F. Kesesuaian Metode Pengukuran Persentase Lemak Tubuh Skinfold Caliper dengan Metode Bioelectrical Impedance Analysis [The Suitability of Skinfold Caliper Body Fat Percentage Measurement Method and Bioelectrical Impedance Analysis Method]. *Jurnal Kedokteran Diponegoro*, **2018**, 7(2), 1504-1510. doi: 10.14710/dmj.v7i2.

65.Muhammad, A.A.Y.; Arief, C.; Andika, C.P.; Astrid, S.D.; Ayatullah, K.; Saptawati, B.; & Eva, S. Prevalensi Obesitas pada Anak Usia 4-6 Tahun dan Hubungannya dengan Asupan Serta Pola Makan [Prevalence of Obesity of Children Aged 4-6 Years and Its Correlation with Food Intake and Dietary Habit]. *Majalah Kedokteran Indonesia*, **2017**, 57(2), 47-53.

66.Adhitya P. Hubungan antara indeks massa tubuh (IMT) dengan nilai lemak visceral [The correlation between body mass index (BMI) and visceral fat]. *Jurnal Media Medika Muda* **2014**, 2(4), 90-95.

67.Sri A.; Nia NW.; Widya R.; Annisa RM. Hubungan Indeks Massa Tubuh, Asupan Lemak, dan Mikronutrisi, serta Aktivitas Fisik terhadap Tekanan Darah pada Wanita Usia Subur [Relationship between Body Mass Index, Fat and Micronutrient Intake, and Physical Activity on Blood Pressure in Women of Childbearing Age] Jurnal Kedokteran Brawijaya, **2019,** 30(4), 277-282

68.Marmi. Gizi Dalam Kesehatan Reproduksi [Nutrition in Reproductive Health]. Pustaka Pelajar; 2014.

69.Shuster A.; Patlas M. Pinthus J. H.; Mourtzakis M. The clinical importance of visceral adiposity: a critical review of methods for visceral adipose tissue analysis. *The British Journal of Radiology*. **2012**, 85(1009),1-10. https://doi.org/10.1259/bjr.20170931.

70.Xu L.; Mitsuhiro K.; Takeshi Y.; Ke J. L. Visceral fat area, waist circumference and metabolic risk factors in abdominally obese Chinese adults. *Biomedical and Environmental Science*. **2012**, 25(2), 141-8 https://doi.org/10.3967/0895-3988.2012.02.003

71.Yulina DH.; Yahwardiah S.; Ramlan S. Analisis Kadar Leptin Pada Obesitas Viseraldan Non Viseral [Analysis of Leptin Level in Viseral and Non-Viseral Obesity]. *Jurnal Pendidikan Kimia*. **2013**, 5(1), 1-9.

72.Purwanti S. Hubungan Indeks Masa Tubuh (IMT) dengan Persen Lemak Tubuh, dan Lemak Viscelar di Kota Semarang," [Relationship between Body Mass Index (BMI) and Percent Body Fat and Viscelar Fat in Semarang City], *Jurnal Gizi* **2021**, 10(1), 51-59. https://doi.org/10.26714/jg.10.1.2021.51-59

73.Ira MS. Kejadian Obesitas, Obesitas Sentral, dan Kelebihan Lemak Viseral pada Lansia Wanita [Occurrence of Obesity, Central Obesity, and Excess Visceral Fat in Elderly Women] *Amerta Nutrition* **2018**, 2(3), 228–236

74.Irianto DP. Panduan Gizi Lengkap (Keluarga dan Olahragawan) [Complete Nutrition Guide (Family and Athlete)]. *Andi Yogyakarta*. **2017**.

75.Amalia, R.; Peggy, S.B. Pengukuran Indeks Massa Tubuh, Asupan Lemak, dan Asupan Natrium Kaitannya dengan Kejadian Hipertensi pada Kelompok Dewasa di Kabupaten Jombang [Measurement of Body Mass Index, Fat Intake, and Sodium Intake in relation to Hypertension among Adults in Jombang District] *Ghidza Media Jurnal* **2018**, 1, 53-62. http://dx.doi.org/10.30587/ghidzamediajurnal.v1i1.1080.

76.Hardinsyah H.; Supariasa S. Ilmu Gizi Teori dan Aplikasi [Science of Nutrition: Theories and Applications]. *Jakarta: EGC*, **2016**.

77.Widodo GM. Asupan Serat dan IMT Wanita Usia Subur Suku Madura di Kota Malang [Fiber Intake and BMI of Women of Reproductive Age Madura Tribe in Malang City]. *Indonesia Journal of Human Nutrition*. **2014**, 1(1), 12.

78.Ratu ADS. Pengaruh Asam Lemak Jenuh, Tidak Jenuh dan Asam Lemak Trans Terhadap Kesehatan [The Effect of Saturated, Unsaturated, and Trans Fats on Health]. *National Public Health Journal*. **2008**, 2(4), 154-160. http://dx.doi.org/10.21109/kesmas.v2i4.258

79.Arisman, D. Buku Ajar Ilmu Gizi Obesitas [Textbook of Obesity Nutrition in Diabetes mellitus & Dislipidemia [Obesity, Diabetes mellitus, and Dyslipidemia]. *EGC*. **2018**, 162-655.

80.Jin W, Chunhe L, Erkang W. Correlation between body mass index and visceral fat. Chin J Health Care Nutr. 2010;20(2):98-100.

81. Ian, J.; Peter, T.K.; Robert, R. Body Mass Index, Waist Circumference, and Health Risk: Evidence in Support of Current National Institutes of Health Guidelines. *Arch. Intern. Med*. **2002**, 162, 2074-2079. https://doi.org/10.1001/archinte.162.18.2074

82. Kevin K. S. Korelasi lingkar pinggang dan indeks massa tubuh dengan tingkat lemak viseral pada mahasiswa Fakultas Kedokteran Universitas Katolik Widya Mandala Surabaya. *Universitas Katolik Widya Mandala Surabaya*, **2016**, 1-81.

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RESEARCH ARTICLE

The Correlation between Age, Fat Intake, and Visceral Fat and Body Mass Index at the Gym

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Abstract:

Background:

This study aimed to investigate the correlation between age, fat intake, visceral fat, and body mass index (BMI) of gym members.

Methods:

A cross-sectional approach was employed with a sample of 87 respondents. Primary data were obtained from three different gyms, while secondary data was obtained from gym owners. A questionnaire was used as the research instrument, and the Chi Square test was used for data analysis.

Results:

The majority of respondents had a higher fat intake than recommended, and most had high levels of visceral fat. In terms of BMI, the majority were classified as either overweight or obese. Bivariate analysis showed significant correlations between age, fat intake, and visceral fat with BMI among gym members.

Conclusion:

This study found that age, fat intake, and visceral fat were significantly correlated with BMI among gym members. The findings suggest the importance of promoting healthy dietary habits and exercise among gym members, particularly those older or with high visceral fat levels.

Keywords: Age, Body mass index, Correlation, Fat intake, Visceral fat, Gymmembers.

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1. BACKGROUND

Health development is an investment in developing socially and economically productive human resources. Indonesia is currently experiencing a double burden, *i.e.*, unresolved communicable disease-related problems and a significant increase in non-communicable diseases [1].

According to WHO statistics, there are more than one billion overweight persons in the globe, which corresponds to an average of one in seven people you interact with on a daily basis.. Of such a number, 475 million people are considered obese. The WHO data also suggest that globally, 2.8 million people die annually due to being overweight and obesity. It is estimated that 35.8 million disability-adjusted life years (DALY) are also due to overweight and obesity [2].

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According to the data from Basic Health Research in 2013 in Palembang, the prevalence of overweight in young adults experienced an increase from 9.3% in 2010 to 12.7% in 2013, and the obesity prevalence grew from 9.3% to 16.7% in 2013. A study conducted by Nyangasa (2019) discovered that 26.4% of 195 people aged ≥18 years were obese with a BMI >26 kg/m2, and the prevalence of waist circumference >88 cm was 24.9% [3]. Overweight and obese people will undergo physiological adaptation, such as increased blood volume, leading to high blood pressure [4]. This indicates that being overweight and obese requires special attention to prevent the risk of metabolic syndrome, including hypertension, often called a "silent killer" because it has no symptoms yet is potentially dangerous [5].

On that ground, it is essential to perform innovative attempts by involving several parties from the central government and local government, community, and entrepreneurs. The attempts are expected to restrain the rate of

obesity prevalence in Indonesia by 15.4% until the end of 2019 as by the indicators in the National Medium-Term Development Plan (RPJMN) of 2015-2019 stipulated in Presidential Regulation Number 2 of 2015.

The prevalence of overweight (BMI ≥ 25 to < 27) and obesity (BMI ≥ 27) among adults has dramatically risen. Besides, obesity has now presented a major challenge to Indonesia. From 2013 to 2018, the prevalence of obesity increased by 6%, higher than the target of RPJMN of 2015-2019 [6].

Gorontalo Province was ranked second among other areas in Indonesia, with an obesity prevalence of 21% higher than the national obesity prevalence of 15.4%. The highest obesity prevalence was in the city of Gorontalo, with 24.2%, and the lowest was in Boalemo Regency, with 13.6% [7, 8]. By taking into account the high prevalence of this problem, a test is required to identify the risk of non-communicable diseases. Being overweight is widely known as pre-obesity yet considered trivial, making it one of the factors contributing to the high prevalence of obesity. People are inattentive in controlling their weight, especially when overweight [1].

According to the National Socio-Economic Survey of Statistics Indonesia (BPS), the consumption of oil and fat per person per day has been increasing nationally, exceeding the recommended limit of 215 kcal per person per day [7]. Fat is a nutrient with the most calories, and high-fat or too much energy-sourced food consumption can result in excessive fat stored in the body's cells. Foods with fat provide more energy than proteins, containing two times more calories [9].

Measuring body fat is crucial to monitor obesity and regulating dietary patterns in healthcare programs. The human body has two types of fat, subcutaneous and visceral [10]. Reduced energy expenditure by the body is due to slow metabolism, physical activity, and food thermic effect. Fat's thermic effect is lower than carbohydrates and protein [11]. Obesity is influenced by dietary habits and food intake [12].

Various health problems, including cardiovascular disease, type 2 diabetes, stroke, breast cancer, colorectal cancer, and Alzheimer's disease, can be triggered by visceral fat accumulation [12]. Studies have shown that there is a correlation between body mass index (BMI) and visceral fat value [13], as well as a correlation between body mass index and fat intake [14].

Based on the Primary data (2021) 12 individuals did not meet the recommended fat intake of an average of 800 kcal or more than 702 kcal or 67 grams, while 3 individuals met the recommended average of 600 kcal or less than 702 kcal or 67 grams. The data was collected using an initial observation with a Bioelectric Impedance Analyzer (BIA) scale, which showed that 14 individuals had a fairly high visceral fat scale and only 1 individual had an ideal healthy visceral fat scale. Furthermore, the initial observation of measuring the body mass index (BMI) revealed that 12 individuals were classified as overweight and 3 individuals were classified as obese (Primary data, 2021).

The present study was conducted in an area where the community has a habit of consuming high-fat foods. One example is some traditional activities that require serving high-fat foods. Furthermore, gym exercise in Gorontalo is not a favored and popular sport in the community; this sport is developing along with the COVID-19 pandemic so people tend to choose indoor sports. In view of the foregoing, this case study was conducted to examine the correlation between age, fat intake, and visceral fat and body mass index of gym members in the city of Gorontalo.

2. METHODS

The research sites comprised Zahra Gym, Atlantik Gym, and D'Master Gym in Gorontalo, Gorontalo Province. The study was conducted from November to December 2022 and employed an analytical survey design with a cross-sectional approach. The population involved 87 male gym members, and the sample was taken using a total sampling technique where the entire population was sampled. The research variables consisted of age, fat intake, visceral fat, and body mass index. The data analysis was conducted using the Spearman Rank Test. The inclusion criteria for this study were individuals who were members of the gym. The exclusion criteria were individuals who were also members of the gym but did not regularly attend the gym. The body mass index (BMI) was calculated using height and weight measurements, age was determined based on the year of birth, fat intake was measured using a questionnaire, and visceral fat was measured using a Bioelectric Impedance Analyzer (BIA). The data analysis was conducted using the Chi-Square test.

3. RESULTS

3.1. Respondents' Characteristics

3.1.1. Distribution of Respondents Based on Age

Provided below are the respondents' characteristics based on age group (Table **1**).

Table 1. Distribution of respondents based on age group.

Age Group (Years)	Total	
	n	%
17 - 25	16	18.4
26 - 35	48	55.2
36 - 45	20	23.0
46 - 55	3	3.4
Sum	87	100.0

Source: Primary Data, 2021.

The above table illustrates that out of 87 respondents, most of them (48 respondents) are aged 26-35 years (55.2%), and the least age group is 46-55 years (three respondents or 3.4%).

3.1.2. Distribution of Respondents based on Sex

The following Table **2** shows the respondents' characteristics based on sex.

As shown in the Table **2** that out of 87 respondents, most of them (77 respondents) are males (88.5%), and the other ten respondents (11.5%) are females.

Table 2. Distribution of respondents based on sex.

Sex	Total	
	n	%
Male	77	88.5
Female	10	11.5
Sum	87	100.0

Source: Primary Data, 2021.

3.2. Univariate Analysis

3.2.1. Distribution of Respondents based on Fat Intake Table 3

Here are respondents' characteristics based on fat intake.

Table 3. Distribution of respondents based on fat intake.

Fat Intake	Total	
	n	%
Meet the recommended intake level	8	9.2
Exceed the recommended intake level	79	90.8
Sum	87	100.0

Source: Primary Data, 2021.

The above table shows that eight respondents (9.2%) have met the recommended fat intake level, and 79 respondents (90.8%) have exceeded the intake level.

3.2.2. Distribution of Respondents based on Visceral Fat as shown in Table 4

Given below are respondents' characteristics based on visceral fat.

Table 4. Distribution of respondents based on visceral fat.

Visceral Fat	Total	
	n	%
Ideal or healthy	4	4.6
Moderate	35	40.2
High	48	55.2
Sum	87	100.0

Source: Primary Data, 2021.

Based on Table **4**, out of 87 respondents, four respondents (4.6%) have an ideal or healthy level of visceral fat, 33 respondents (37.9%) and 50 respondents (57.5%) have moderate and high levels of visceral fat, respectively.

3.2.3. Distribution of Respondents based on Body Mass Index

The following table provides respondents' characteristics based on body mass index.

Table 5. Distribution of respondents based on body mass index.

Body Mass Index (BMI)	Total	
	n	%
Normal 18.5 - 25.0	28	32.2
Overweight 25.1 - 27.0	20	23.0
Obese > 27.0	39	44.8
Sum	87	100.0

Source: Primary Data, 2021.

Table **5** illustrates that 28 respondents (32.2%) have normal BMI, 20 respondents (23.0%) are overweight, and 39 respondents (44.8%) are obese.

3.3. Bivariate Analysis

3.3.1. The Analysis Result of the Correlation between Age and Body Mass Index of Gym Members in Gorontalo

The analysis result of the correlation between age and body mass index is presented below.

Based on Table **6**, it can be seen that the respondents aged 17-25, with a total of 20 respondents, have a normal body mass index (BMI) category of 14 respondents (16.1%), overweight category of 4 respondents (4.7%), and very overweight category of 2 respondents (2.3%). The respondents aged 26-35, with a total of 21 respondents, have a normal BMI category of 5 respondents (5.7%), overweight category of 7 respondents (8.0%), and a very overweight category of 9 respondents (10.3%). The respondents aged 36-45 a total of 40 respondents, have a normal BMI category of 8 (9.2%), overweight category of 7 respondents (8.0%), and very overweight category of 25 respondents (28.7%). The respondents aged 46-55, with a total of 6 respondents, have a normal BMI category of 1 (1.2%), overweight category of 2 respondents (2.3%), and very overweight category of 3 respondents (3.5%). Based on the test results, the p-value obtained was 0.001 or α value <0.05, which means that there is a relationship between age and BMI.

3.3.2. The Analysis Result of the Correlation between fat Intake and Body Mass Index of Gym Members in Gorontalo

The analysis result of the correlation between fat and body mass index is illustrated in the following table.

Based on Table **7**, it can be seen that the majority of respondents have a normal fat intake category with a total of 79 respondents, where 21 respondents (24.2%) have a normal BMI category, 20 respondents (23.0%) are overweight, and 38 respondents (43.7%) are very overweight. The least number of respondents is in the category of very overweight with a low fat intake, with only 1 respondent (1.1%). Based on the test results, the obtained p-value was 0.002 or α value <0.05, which means that there is a relationship between fat intake and BMI.

3.3.3. The Analysis Result of the Correlation between Visceral Fat and Body Mass Index of Gym Members in Gorontalo

Provided below is the analysis result of the correlation between visceral fat and body mass index.

Based on Table **8**, it can be seen that the largest number of respondents is in the very high category, with a total of 48 respondents, where 10 respondents (11.5%) have a normal BMI category, 10 respondents (11.5%) are overweight, and 28 respondents (32.2%) are very overweight. The least number of respondents is in the healthy ideal range, with a total of 4 respondents, where 2 respondents (2.3%) have a normal BMI category, 2 respondents (2.3%) are overweight, and 0 respondents (0%) are very overweight. Based on the test results, the obtained p-value was 0.029 or α value <0.05, which means that there is a relationship between visceral fat and BMI.

4. DISCUSSION

4.1. Fat Intake

The measurement of energy intake relied on a semi-quantitative food frequency questionnaire method, in which eight respondents (9.2%) met the recommended fat intake level, while 79 respondents (90.8%) exceeded the limit. These 79 respondents regularly consumed staple foods with a significant portion, fritters, noodles, meatballs, and local snacks high in calories. They consumed such foods every day or four to six times a week. On the other hand, respondents with a healthy fat intake solely consumed staple foods without excessive supplementary foods, making their calorie intake reach 80% of the RDA. This is because the respondents are used to eating a small amount of food.

Fat is an important energy source in the body and serves several other crucial functions. It produces more energy per gram than carbohydrates or protein, acts as a structural building block for the body, regulates body temperature, and offers protection against rapid heat loss. Fat also produces essential fatty acids and serves as a solvent for fat-soluble vitamins [15].

However, excessive fat intake can lead to an increased risk of obesity and fat mass accumulation. A study of 148 participants found that 90.5% of them had excessive fat intake [16]. This highlights the importance of maintaining a balanced and healthy diet to avoid the negative consequences of excessive fat consumption. The ethical authority for the research is the Department of Public Health, Gorontalo State University. This research has obtained an Ethical Clearance Recommendation Letter Number: 13/UN47.B7/KE/2023.

4.2. Visceral Fat

This study utilized bioelectrical impedance analysis to measure the level of visceral fat in 87 respondents. The results showed that the majority of respondents (57.5%) had a high level of visceral fat, while only a small proportion (4.6%) had an ideal or healthy level of visceral fat [17].

Visceral fat is a type of adipose tissue that accumulates in the intra-abdominal area and is stored deeper beneath the skin than subcutaneous fat. Obese individuals with visceral fat tend to have increased secretion of inflammatory mediators, indicating ongoing chronic inflammation in their adipose tissue. This chronic inflammation is associated with various health risks, such as hypertension, diabetes, and cardiovascular disease [18].

The distribution of fat in different areas of the body has implications for morbidity, with abdominal fat and intra-abdominal fat having a greater impact on health risks than fat distributed in other areas of the body. A prospective study utilizing anthropometric measurements found that visceral obesity is closely related to health risks such as hypertension, diabetes, and cardiovascular disease [19].

Decades of research have shown that abdominal fat is strongly associated with cardiometabolic risk factors beyond obesity itself, and targeting abdominal fat is a key strategy for preventing and managing health risks associated with abdominal obesity [19]. A systematic review has confirmed that negative energy balance from exercise or diet is associated with a significant reduction in abdominal fat and related cardiometabolic risk factors [19].

Purwanti Susantini found that a significant proportion of respondents (18.3%) had a high visceral fat level, with 8.7% of respondents having an extremely high visceral fat level [20]. Visceral fat is located inside the peritoneal cavity and is wrapped around internal organs. Excessive visceral fat is strongly associated with an increased risk for cardiovascular disease, metabolic syndrome (including hypertension, dyslipidemia, and type II diabetes), and insulin resistance [20]. Studies have shown that obese individuals are more likely to have excessive visceral fat, and that visceral fat can contribute to waist circumference, making central obesity a higher risk for those with a higher percentage of visceral fat [21].

4.3. Body Mass Index

In this study, a scale and microtoise were used to measure the body mass index of 87 respondents. The results showed that 28 respondents (32.2%) had a normal body mass index, 20 respondents (23.0%) were overweight, and 39 respondents (44.8%) were obese. Body mass index is a method used to measure an individual's nutritional status, which is indicative of malnutrition or overnutrition. According to Irianto, [22], body mass index is used to determine the nutritional status of individuals who are 18 years of age or older. It is important to note that self-reported weight and height can be systematically compared to objectively measured body mass index calculation data. However, errors in self-reported weight and height can lead to significant misclassification in the body mass index category.

Body composition is determined by height, weight, and fat thickness. To measure height accurately, individuals should stand straight with their feet flat on the floor and their heels against the corner where the wall and floor meet, while their shoulders, buttocks, and hips touch the wall.

The present study's findings are consistent with those of a previous study by Amalia Rahma and Peggy Setyaning Baskari, which showed that out of 148 respondents, four respondents (2.70%) had a body mass index (BMI) of <18.5, 34 respondents (22.97%) had a BMI of 18.5-22.9, 44 respondents (29.72%) had a BMI of 23-24.9, 48 respondents (32.43%) had a BMI of 25-29.9, and 18 respondents (12.16%) had a BMI of >30 [16]. Increasing BMI is associated with an increase in body weight and the accumulation of fat in the body.

4.4. The Correlation between Age and Body Mass Index of Gym Members in Gorontalo

Based on Table **6**, it can be seen that the respondents are in the age categories of 17-25 with a total of 20 respondents, where 14 respondents (16.1%) have a normal BMI category, 4 respondents (4.7%) are overweight, and 2 respondents (2.3%) are very overweight. For respondents in the age category of 26-35, with a total of 21 respondents, 5 respondents (5.7%) have a normal BMI category, 7 respondents (8.0%) are overweight, and 9 respondents (10.3%) are very overweight.

For respondents in the age category of 36-45 with a total of 40 respondents, 8 respondents (9.2%) have a normal BMI category, 7 respondents (8.0%) are overweight, and 25 respondents (28.7%) are very overweight. For respondents in the age category of 46-55 with a total of 6 respondents, 1 respondent (1.2%) has a normal BMI category, 2 respondents (2.3%) are overweight, and 3 respondents (3.5%) are very overweight. Based on the test results, the obtained p-value was 0.001 or α value <0.05, which means that there is a relationship between age and BMI.

The correlation between age and body mass index was analyzed using the Chi-Square test. The results showed a p-value of 0.12 (p or $\alpha < 0.05$), indicating no significant correlation between age and body mass index. The correlation coefficient (r-value) was calculated to be 0.24, suggesting a very weak correlation.

4.5. The correlation between fat intake and body mass index of gym members in Gorontalo

According to Table **7** , it can be seen that the majority of respondents had a normal category of fat intake with a total of 79 respondents, of which 21 had a normal body mass index (24.2%), 20 were overweight (23.0%), and 38 were very overweight (43.7%). The fewest respondents were in the low-fat intake category with only 1 respondent (1.1%) in the very overweight category. Based on the test results, a p-value of 0.002 or $\alpha < 0.05$ was obtained, indicating that there is a relationship between fat intake and body mass index.

The Chi-Square test was used to analyze both variables, fat intake and body mass index, to determine their correlation. The results show a p-value of 0.03 (p or $\alpha < 0.05$), indicating that there is a correlation between fat intake and body mass index. The correlation coefficient (r-value) is 0.31, representing a moderate correlation.

Fat is an important source of energy and helps with the absorption of fat-soluble vitamins [15]. Vegetable fat is recommended as it contains essential fatty acids that can prevent cholesterol build-up and blood vessel constriction [15]. The RDA for fat intake in adolescents aged 10 to 18 years old ranges from 70 to 89 grams per day for boys and 67 to 71 grams per day for girls [23].

A study conducted by Gagah Mukti Widodo found a significant correlation between fat intake and body mass index with a p-value of 0.04 and a correlation coefficient (r) of 0.208 [24]. This indicates a low but definite correlation between the two variables, with the higher fat intake associated with a higher body mass index [24]. These results are consistent with the work of Sari, who reported that long-term consumption of fat increases the risk of overnutrition and obesity [25].

One participant in the study met the recommended fat intake level but was still obese due to excess body weight from muscle and bone. Additionally, 21 respondents exceeded the recommended fat intake level but had a normal body mass index because they engaged in regular exercise and monitored their body mass index.

4.6. The Correlation between Visceral Fat and Body Mass Index of Gym Members in Gorontalo

Based on Table **8** , it can be seen that most respondents were in the very high category, with a total of 48 respondents, with a normal BMI of 10 respondents (11.5%), overweight 10 respondents (11.5%) and very obese 28 respondents (32.2%). The fewest respondents were in the healthy ideal range, with a total of 4 respondents, with a normal BMI of 2 respondents (2.3%), overweight 2 respondents (2.3%) and very obese 0 respondents (0%). Based on the test results, a p-value of 0.029 or $\alpha < 0.05$ was obtained, indicating a relationship between visceral fat and BMI.

Table 6. Analysis result of the correlation between age and body mass index of gym members.

Age	Body Mass Index						Total		r-value	p-value
	Normal		Overweight		Obese					
	n	%	n	%	n	%	n	%		
17-25	6	37.5	6	37.5	4	25	16	100	**0.24**	**0.12**
26-35	15	31.5	10	20.8	23	47.9	48	100		
36-45	7	35	2	10	11	55	20	100		
46-55	0	0	2	66.7	1	33.3	3	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021.

Table 7. Analysis result of the correlation between fat intake and body mass index of gym members.

Fat Intake	Body Mass Index						Total		r-value	p-value
	Normal		Overweight		Obese					
	n	%	n	%	n	%	n	%		
Meet the recommended intake level	7	87.5	0	0	1	12.5	8	100	**0.31**	**0.03**
Exceed the recommended intake level	21	26.6	20	25.3	38	48.1	79	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021.

Table 8. Analysis result of the correlation between visceral fat and body mass index of gym members.

Visceral Fat	Body Mass Index						Total		r-value	p-value
	Normal		Overweight		Obese					
	n	%	n	%	n	%	n	%		
Ideal/healthy	2	50	2	50	0	0	4	100	0.33	0.02
Moderate	16	45.7	8	22.9	11	31.4	35	100		
High	10	20.8	10	22.8	28	58.3	48	100		
Sum	**28**	**32.2**	**20**	**23**	**39**	**44.8**	**87**	**100**		

Source: Primary Data, 2021.

Both variables were analyzed using the chi-square test to see if there was a relationship or association between visceral fat and BMI. A significant p-value of 0.029 was obtained, indicating that there is a relationship between visceral fat and BMI.

Visceral fat is an accumulation of intra-abdominal fat (central obesity) that is stored beneath the skin deeper than subcutaneous fat [17]. The increase in the secretion of inflammatory mediators in the visceral fat of obese people reflects ongoing chronic inflammation within the people's adipose tissue [18].

From the data collected by Epic Wellness, it has been found that visceral fat can lead to various health risks. Visceral fat can increase the release of proteins and hormones that trigger inflammation, which in turn can damage arteries and liver function. This makes it difficult for the body to break down sugar and fat. Visceral fat can also increase the production of low-density lipoprotein, commonly known as "bad" cholesterol, which can ultimately lead to inflammation and narrowing of arteries. This condition can increase blood pressure, strain the heart, and increase the risk of blood clotting.

Studies have shown that visceral fat is one of the body's components that can affect body weight. Body mass index is an indicator of one's nutritional status by calculating height and weight, so visceral fat, as a body component, can also affect body mass index [26].

The current study's findings are consistent with previous research [13, 27, 28] that has reported a significant positive correlation between body mass index (BMI) and visceral fat. Jin *et al*. found a significant correlation between BMI and visceral fat with $p<0.01$ [4]. Ratu also reported a positive correlation between BMI and visceral fat with $r=0.60$ [27], while Ian *et al*. suggested an association between an increase in BMI and an increase in visceral fat [28].

Furthermore, Adhitya Pradana's case study [13] on medical students at Diponegoro University and Kevin Kurniawan Soegeng's study on medical students at Surabaya Widya Mandala Catholic University also supported these findings. Adhitya Pradana reported a positive correlation between BMI and visceral fat with $p=0.005$ and $r=0.912$ [28]. Kevin Kurniawan Soegeng found a significant correlation between waist circumference, BMI, and visceral fat with $p=0.000$ and $r=0.513$ for waist circumference and visceral fat, and $p=0.000$ and $r=0.651$ for BMI and visceral fat [29].

Two respondents have ideal or healthy visceral fat, yet they are overweight as the visceral fat is only stored in the waist circumference. Although one's waist circumference is ideal yet has an overweight body mass index, fat may accumulate in other body parts, such as upper arm and thigh. Next, 16 respondents have a moderate level of visceral fat with a normal body mass index because they do not control their visceral fat. They only build muscles and bones and still consume more fats, leading to fat accumulation in the abdomen.

CONCLUSION

Based on the research on the relationship between age, fat intake, and visceral fat with body mass index among gym members in a gym in Gorontalo city, the following conclusions can be drawn:

a. There is a relationship between age and body mass index among gym members, with a significant value of p value = 0.001 ($> \alpha = 0.05$).

b. There is a relationship between fat intake and body mass index among gym members, with a significant value of p-value = 0.002 ($< \alpha = 0.05$).

c. There is a relationship between visceral fat and body mass index among gym members, with a significant value of p-value = 0.029 ($< \alpha = 0.05$).

LIST OF ABBREVIATIONS

DALY	=	Disability-adjusted life years
BMI	=	Body mass index

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This research has obtained an Ethical Clearance Recommendation Letter Number: 13/UN47.B7/KE/2023.

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committees and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this study are available within the article.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Declared none.

REFERENCES

[1] Ministry of Health of the Republic of Indonesia. Profil Kesehatan Republik Indonesia Tahun 2020 [Health Profile of the Republic of Indonesia in 2020]. Kemenkes RI. 2020.

[2] World Health Organization. Obesity and overweight. World Health Organization Western Pacific Region. Available from: http://www.who.int/mediacentre/factsheets/fs311/en/index.html Accessed on: Jan 10, 2022.

[3] Nyangasa MA, Buck C, Kelm S, Sheikh MA, Brackmann KL, Hebestreit A. Association between cardiometabolic risk factors and body mass index, waist circumferences and body fat in a Zanzibari cross-sectional study. BMJ Open 2019; 9(7): e025397. [http://dx.doi.org/10.1136/bmjopen-2018-025397] [PMID: 31278089]

[4] Wang J, Li C, Wang E. Potential and flux landscapes quantify the stability and robustness of budding yeast cell cycle network. Proc Natl Acad Sci USA 2010; 107(18): 8195-200. [http://dx.doi.org/10.1073/pnas.0910331107] [PMID: 20393126]

[5] Buford TW. Hypertension and aging. Ageing Res Rev 2016; 26: 96-111. [http://dx.doi.org/10.1016/j.arr.2016.01.007] [PMID: 26835847]

[6] Ministry of Health of the Republic of Indonesia. Obesity Epidemic in Obesity FactSheet. Directorate of Prevention and Control of Non-Communicable Diseases, Directorate General of Disease Prevention and Control. 2018.

[7] Ministry of Health of the Republic of Indonesia. Profil Kesehatan Republik Indonesia Tahun 2013 [Health Profile of the Republic of Indonesia in 2013]. Kemenkes RI. 2013.

[8] Statistik BP. National Socio-Economic Survey. BPS 2020.

[9] Etisa AM, Lailatul F. The correlation between body fat percentage and physical activity and adolescents' physical fitness level. J Nutr Health 2017; 5(2): 69-84. [http://dx.doi.org/10.14710/jnh.5.2.2017.69-84]

[10] Dwi NW, Hermina S, Deny YF. The suitability of skinfold caliper body fat percentage measurement method and bioelectrical impedance analysis method. Jurnal Kedokteran Diponegoro 2018; 7(2): 1504-10. [http://dx.doi.org/10.14710/dmj.v7i2]

[11] Muhammad AAY, Arief C, Andika CP, *et al*. Prevalence of obesity of children aged 4-6 years and its correlation with food intake and dietary habit. Madjalah Kedokt Indones 2017; 57(2): 47-53.

[12] Adhitya P. The correlation between body mass index (BMI) and visceral fat. Jurnal Media Medika Muda 2014; 2(4): 90-5.

[13] Andarini S, Wirawan NN, Rahmawati W, Maulidiana AR. Relationship between body mass index, fat and micronutrient intake, and physical activity on blood pressure in women of childbearing age. Jurnal Kedokteran Brawijaya 2019; 30(4): 277-82. [http://dx.doi.org/10.21776/ub.jkb.2019.030.04.8]

[14] Pushkar Pelajar, Ed. Text book of Mary. Nutrition in Reproductive Health. 2014.

[15] Shuster A, Patlas M, Pinthus JH, Mourtzakis M. The clinical importance of visceral adiposity: A critical review of methods for visceral adipose tissue analysis. Br J Radiol 2012; 85(1009): 1-10. [http://dx.doi.org/10.1259/bjr/38447238] [PMID: 21937614]

[16] Li X, Katashima M, Yasumasu T, Li KJ. Visceral fat area, waist circumference and metabolic risk factors in abdominally obese Chinese adults. Biomed Environ Sci 2012; 25(2): 141-8. [http://dx.doi.org/10.3967/0895-3988.2012.02.003] [PMID: 22998819]

[17] Yulina DH, Yahwardiah S, Ramlan S. Analysis of Leptin Level in Viseral and Non-Viseral Obesity. Jurnal Pendidikan Kimia 2013; 5(1): 1-9.

[18] Susantini P. Relationship between Body Mass Index (BMI) and Percent Body Fat and Viscelar Fat in Semarang City. J Gizi 2021; 10(1): 51-9. [http://dx.doi.org/10.26714/jg.10.1.2021.51-59]

[19] Sofa IM. Occurrence of Obesity, Central Obesity, and Excess Visceral Fat in Elderly Women. Amerta Nutrition 2018; 2(3): 228-36. [http://dx.doi.org/10.20473/amnt.v2i3.2018.228-236]

[20] Irianto DP. Complete Nutrition Guide (Family and Athlete). Andi Yogyakarta 2017.

[21] Rahma A, Baskari PS. Measurement of Body Mass Index, Fat Intake, and Sodium Intake in relation to Hypertension among Adults in Jombang District. Ghidza Media Jurnal 2019; 1(1): 53-62. [http://dx.doi.org/10.30587/ghidzamediajurnal.v1i1.1080]

[22] Hardinsyah H, Supariasa S. Science of Nutrition: Theories and Applications. Jakarta: EGC 2016.

[23] Widodo GM. Fiber intake and BMI of women of reproductive age madura tribe in malang city. Ind J Human Nutr 2014; 1(1): 12.

[24] Sartika RAD. The effect of saturated, unsaturated, and trans fats on health. Kesmas: Nat Pub Health J 2008; 2(4): 154-60. [http://dx.doi.org/10.21109/kesmas.v2i4.258]

[25] Arisman D. Textbook of Obesity Nutrition in Diabetes mellitus & Dislipidemia [Obesity, Diabetes mellitus, and Dyslipidemia]. EGC 2018.

[26] Jin W, Chunhe L, Erkang W. Correlation between body mass index and visceral fat. Chin J Health Care Nutr 2010; 20(2): 98-100.

[27] Janssen I, Katzmarzyk PT, Ross R. Body mass index, waist circumference, and health risk: evidence in support of current National Institutes of Health guidelines. Arch Intern Med 2002; 162(18): 2074-9. [http://dx.doi.org/10.1001/archinte.162.18.2074] [PMID: 12374515]

[28] Kevin KS. Correlation between waist circumference and body mass index with visceral fat levels in students of the Faculty of Medicine, Widya Mandala Catholic University, Surabaya. Widya Mandala Catholic University, Surabaya 2016; pp. 1-81.